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United States Air Force

Bioventing at Operable Units 5, 8, 9, 10, and 11

DRAFT

Loring Air Force Base

SEMIANNUAL REPORT

June 1997

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AQM01-01-0303

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Loring Air Force Base

BIOVENTING AT OPERABLE UNITS 5, 8, 9, 10, AND 11

SEMIANNUAL REPORT

DRAFT

Prepared for:
Department of the Air Force
Air Force Center for Environmental Excellence (AFCEE)
Brooks Air Force Base, Texas 78235-5328

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Contract No. F41624-94-D-8072
Job No. 22784

June 1997
Revision B

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Approved	BEI Project Engineer	6/6/97 Date
Approved	BEI Project Manager	6/6/97 Date

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ACRONYMS AND INITIALISMS

AFB	Air Force Base
AFCEE	Air Force Center for Environmental Excellence
AHS	Auto Hobby Shop
AIW	air injection well
BEI	Bechtel Environmental, Inc.
bgs	below ground surface
BS	bioslurp points
BV	biovent points
BXSS	Base Exchange Service Station
COE	U.S. Core of Engineers
ES	Entomology Shop
FJETC	Former Jet Engine Test Cell
FTA	Fire Training Area
FTF	Fuel Tank Farm
MP	monitoring point
NDA	Nose Dock Area
O&M	operations and maintenance
OU	operable unit
PPDP	Power Plant Drainage Pipe
TVH	total volatile hydrocarbon
VM	vapor monitoring point
VMB	Vehicle Maintenance Building

UNITS OF MEASURE

cfm	cubic foot per minute
ft	foot
hr	hour
lb	pound
ppm	parts per million
psi	pounds per square inch
scfm	standard cubic foot per minute

1.0 INTRODUCTION

This semiannual bioventing report presents information gathered from operation and maintenance (O&M) activities performed by Bechtel Environmental, Inc. (BEI) on the bioventing systems at Loring Air Force Base (AFB), Maine. Work was conducted under Contract No. F41624-94-D-8072, Delivery Order 0004, for the Air Force Center for Environmental Excellence (AFCEE). This report covers 5 months of O&M activities at 16 bioventing systems from September 1, 1996, to February 1, 1997. Table 1-1 briefly summarizes operations at each bioventing site, including the number of air injection wells (AIWs), monitoring points (MPs), and oxygen sensors. Table 1-1 also includes the oxygen utilization rate ranges measured during the summer and fall 1996 respiration tests at each of the sites. This semiannual report is also intended to cover information gathered during January 1997, replacing the January bioventing monthly report.

The objective of this report is to present operations data and an evaluation of bioventing system performance, including site status, problems identified, and recommendations. Operations guidance is summarized on a flow chart in Figure 1-1. This guidance facilitates identification of needed system changes during normal operations and when the site is nearing completion of remediation.

A pilot-scale treatability study at the Base Exchange Service Station (BXSS) determined bioventing was a viable remedial technology (Earth Tech 1995) for petroleum-contaminated soils at Loring AFB. The BXSS treatability study report presented preliminary information and established basic design parameters. Based on the BXSS treatability study, bioventing was selected as the preferred removal action treatment technology at 16 sites contained in 5 operable units (OUs) at Loring AFB. Bioventing systems were installed and started at four of these sites in the fall of 1995:

- Former Jet Engine Test Cell (FJETC)
- Fire Training Area (FTA)
- Power Plant Drainage Pipe (PPDP)
- Vehicle Maintenance Building (VMB)

These units were then turned over to AFCEE on February 1, 1996, with BEI performing the O&M. The O&M for the BXSS site, which had been operating since the fall of 1993, was also taken over by BEI on February 1, 1996. Additional MPs and AIWs were installed and system modifications were performed at the BXSS site by the U.S. Army Corps of Engineers (COE) during the summer and fall of 1996. The other 11 sites were constructed and began operation in the fall of 1996. BEI began performing the O&M for these units on December 1, 1996. The remaining sites include:

- Auto Hobby Shop (AHS)
- Entomology Shop (ES)
- Fuel Tank Farm (FTF)
- Nose Dock Area(s) (NDA) 1 through 8

Table 1-1
Biovent System Summary

Site	Number of AIWs	AIWs accepting flow in Jan. 97	Number of MPs[1]	MP w/ Dec. data[2] 1996	Number of O_2 sensors	Total operation (days)[3]	O_2 utilization rate %/hr[4]	Observations/comments
AHS	19	19	19	6	5	94	0.04-7.5	Background location potentially contaminated.
BXSS	7	7	12	5	0	301	0.11-1.3	Background location potentially contaminated.
ES	7	4	10	1	0	122	0.01	More soil gas data needed.
FJETC	13	5	7	4	0	222	0.66	High water levels continue to impede monitoring.
FTA	16	12	37	12	0	328	0.17-1.45	
FTF	20	15	15	1	4	77	0.4-0.77	MP-8 area not being aerated.
NDA-1	24	18	10	2	1	95	4.0-5.1	
NDA-2	23	18	9	1	0	97	0.7	
NDA-3	21	9	4	0	0	99	not tested	
NDA-4	36	18[5]	15	2	1	102	not tested	
NDA-5	29	22	7	1	1	100	0.05-7.2	
NDA-6	4	1[5]	3	2	1	95	not tested	
NDA-7	4	0	1	0	0	98	not tested	No injection of air occurring.
NDA-8	23	10	2	0	0	99	not tested	
PPDP	18	17	21	5	0	298	0.15-1.7	High water levels in southern end.
VMB	25	24	31	2	0	285	0.63	Confirmation of soil samples recommended.

[1]Number of monitoring points denotes number of monitoring points with and without oxygen sensors.
[2]Measurements not collected in January 1997 due to freezing.
[3]As of January 31, 1997.
[4]Range of values from summer and fall 1996 measurements.
[5]Three AIWs turned off.

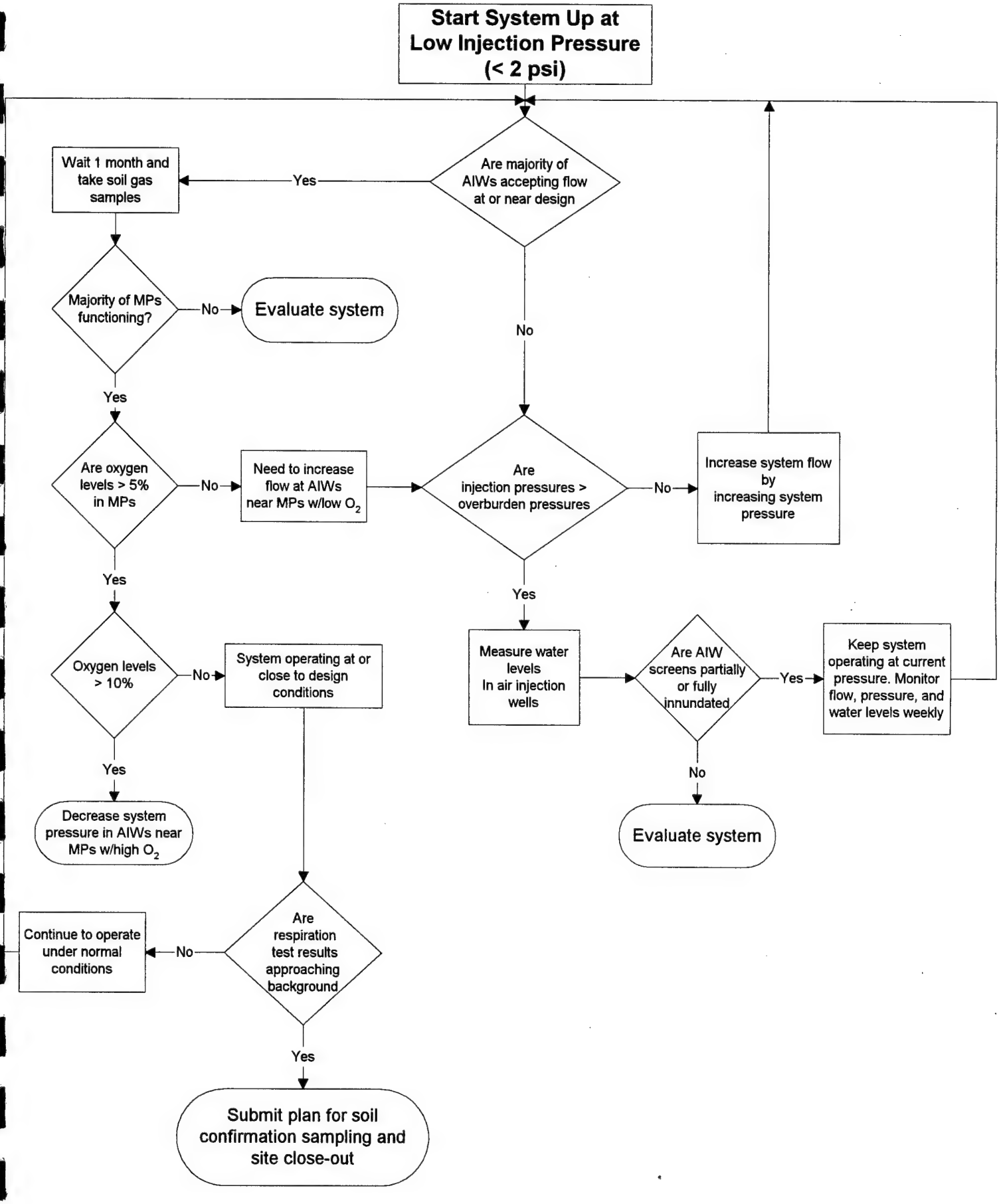

Figure 1-1 Bioventing Process

Overall, a significant amount of information was gained from operating the biovent systems over the previous year. This includes developing an understanding of the biovent systems in relationship to the hydrogeology. Figure 1-2 shows a conceptual model of the bioventing site. In general, each site consists of glacial till, either natural or worked, and lenses of higher permeability material (e.g., gravel, sand). Perched water exists in many forms and most likely exists in these lenses. The overburden groundwater table is usually below the area being treated by bioventing. Most water influences on the injection of air, therefore, are caused by perched groundwater. The location of the MP, and hence collection of soil gas samples, is also affected by perched water.

Advective airflow occurs primarily through the regions of higher permeability. In regions of lower permeability, aeration of the soils occurs through diffusive transport. Even though soil gas samples may not be drawn from several MPs, aeration is likely occurring to support biodegradation, but at a reduced rate.

Documents applicable to the bioventing system design, testing, installation, and O&M include:

- *Final Remedial Investigation Reports, Operable Units 5, 8, 9, 10, and 11* (CDM 1996, ABB-ES 1995a, ABB-ES 1995b, ABB-ES 1994, ABB-ES 1996, respectively)
- *Test Plan and Technical Protocol for a Field Treatability Test for Bioventing* (AFCEE 1992)
- *Long-Term Bioventing Treatability Study, Loring AFB, Base Exchange Service Station* (Earth Tech 1995)
- *Operation and Maintenance Manuals for Nose Dock Area & Service Station* (Patrick St. Peter & Sons Inc. 1997)
- *Design Analysis Report, Operable Units 5, 9, 10, and 11* (URS 1995a)
- *Bioventing and Excavation Specifications for Former Jet Engine Test Cell, Vehicle Maintenance Building, Power Plant Drainage Pipe, and Entomology Shop* (URS 1995b)
- *Bioventing at Operable Units 5, 8, 9, 10, and 11 Removal Action Report* (BEI 1996a)
- *Operation and Maintenance Plan for Bioventing at Operable Units 5, 8, 9, 10, and 11* (BEI 1996b)
- *Excavations in OUs 5, 8, 9, 10, and 11 Removal Action Report* (BEI 1996c)
- *Bioventing at OUs 5, 8, 9, 10, and 11 Removal Action Work Plan,* Addendum #1 (BEI 1996d)
- *Biovent Semi-Annual Report* (BEI 1996e)
- *Bioventing Alternatives Technical Memorandum* (BEI 1996f)
- *Monthly Bioventing Reports* (BEI 1996g through j)
- Draft *Bioventing Removal Action Report Addendum 1* (BEI 1997)

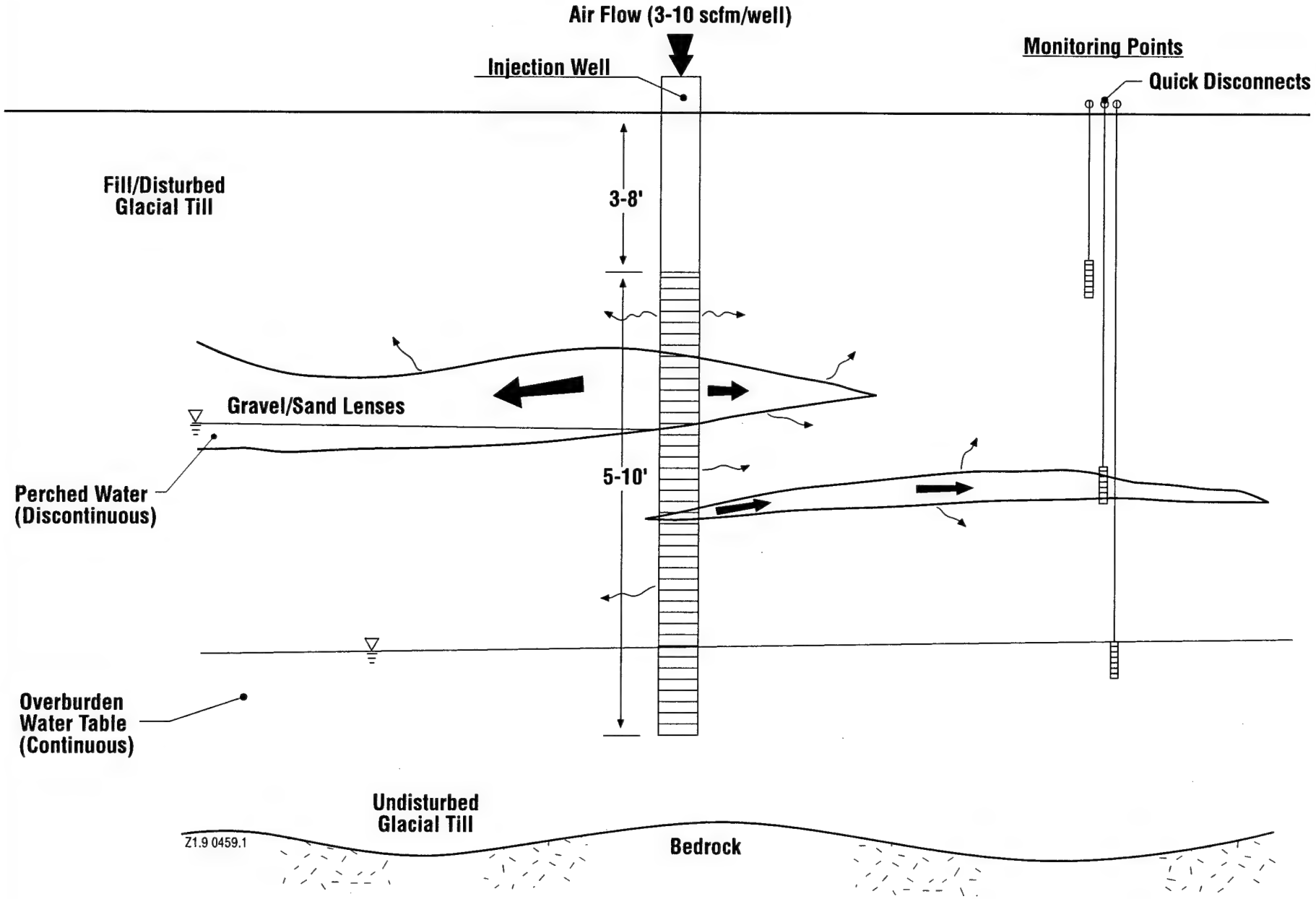

Figure 1-2 Bioventing Conceptual Model

2.0 SYSTEM MAINTENANCE

Routine weekly, monthly, and time-driven maintenance activities were performed in accordance with work plan specifications. These activities included checking lubrication levels, air drier desiccant levels, and blower drive belts; draining fluids from air drier tanks; replacing blower belt drives; and changing motor oil. Other activities included updating telemetry system software to a full Windows 3.1 package.

During the period of this report there were no equipment problems. Several power outages occurred at the FTA, due to base activities, causing the system to be shut down for up to a week at a time.

No well seals have been documented to be leaking since the operation pressures have been closely monitored and upper pressure limits have been specified. Three wells at NDA-4 (AIW-4, AIW-5, and AIW-10) had air leakage through the well seals and are currently shut down. The compromise of the well seal is due to improper installation and not operational methods. Repairing the well seals is a punchlist item to be completed by COE in the spring.

Site and well access was the greatest operational challenge encountered during this reporting period because of cold weather and snow. Snow removal is accomplished through a joint effort between Loring AFB and BEI personnel. Snowshoes are used to gain access to wellhead locations.

3.0 SYSTEMS OPERATION AND RECOMMENDATIONS

Key operational activities observed over the first year are discussed in Section 3.1. Section 3.2 summarizes problems encountered and lessons learned over the past year. Sections 3.3 through 3.11 will present operations data, conclusions drawn, and recommendations made, on a site-per-site basis, for each of the 16 individual bioventing sites.

Operational data collected during this report period includes monthly flow measurements taken at each AIW, monthly soil gas sampling results from MPs, and in situ respiration results from the fall 1996 tests. Oxygen sensors were included in the systems installed by COE and were activated in December 1996. Data downloaded from the oxygen sensors are included in the data tables.

3.1 OPERATIONS SUMMARY

The flow rates to the wellheads determine the rate at which oxygen is supplied to the subsurface. The wellhead flow rate is a function of soil characteristics (e.g., permeability, saturation). Generally, the tighter the soils (lower permeability) the lower the flow rate at a given pressure. Since the injection pressure is directly related to the flow rate, an increase in pressure results in greater flow rates. If the injection pressure is too high, however, fracturing of the soil may occur, resulting in macropathways for the air and negating any benefit for increased airflow. The maximum allowable injection pressure varies by site and depth of the AIW screen interval, but is generally kept less than 5 psi (equivalent of approximately 10 ft of overburden pressure).

Overburden pressures were calculated at the depth of the top of the screen for each of the AIWs. A density of 100 lbs/ft^3 was assumed for the soil. These values are provided on each of the site-specific data tables presented in Sections 3.3 through 3.11.

Total monthly airflow (up to 12 months of data) at each site is plotted in Figure 3-1. In general, total flow at each system increased over the period of this report.

Soil gas samples are collected to determine whether subsurface aeration is occurring. The AFCEE protocol recommends maintaining an oxygen level of at least 5 percent, which is the suggested level required to maintain oxygen limited aerobic degradation (AFCEE 1992). This level is used as a reference point for the operation of the biovent systems. Oxygen levels are measured by taking soil gas samples from the MPs or by in situ oxygen meters. If oxygen levels are found to be below 5 percent at any MP, the flow rates from adjacent AIWs increased to raise oxygen concentrations at that location.

In many instances, soil gas samples cannot be taken from the MPs. The lack of soil gas can be attributed to soil saturation, low permeability soil, screen clogging, or frozen tubing (winter months). For the COE systems, only data collected in December 1996 after the start of O&M are presented. No soil gas sampling was performed in January because the MPs were frozen.

In situ respiration tests are performed semiannually. Due to the weather patterns at Loring AFB, these tests are generally performed in the early summer and fall. Conditions such as the MPs freezing during the winter and high water levels in the spring make it difficult to perform respiration tests during this period (November to May). The in situ respiration tests are performed and analyzed in accordance with the design specifications (URS 1995b) and AFCEE protocol (AFCEE 1992). These tests require injection of an air/helium mixture into MPs for 20 hours (helium is injected as a tracer). After this injection period, the air/helium source is removed and soil gas samples are taken. The soil gas samples are analyzed by field instruments for oxygen, carbon dioxide, helium, and total volatile hydrocarbons (TVH). The test is concluded once oxygen levels decrease below 5 percent or 72 hours have passed. Oxygen utilization rates are then calculated based on the initial linear portion of the curve. Operation of the biovent system is to be continued until a site's respiration rate matches background levels. At Loring AFB, the background oxygen utilization rate was found to be 0.1 percent/hr (2.4 percent/day) or less. A summary of all in situ respiration tests run in the summer and fall of 1996 is presented in Table 3-1 and graphically in Figure 3-2.

3.2 LESSONS LEARNED SUMMARY

System performance improved over the past year due to increased system operation knowledge. Challenges encountered over the past year included well seal leaks, inaccurate flow measurements, inundation of AIWs, and lack of soil gas samples. These items are discussed in more detail in the first semiannual report (BEI 1996e) but are included in this report for reference.

Figure 3-1
Monthly Air Flow

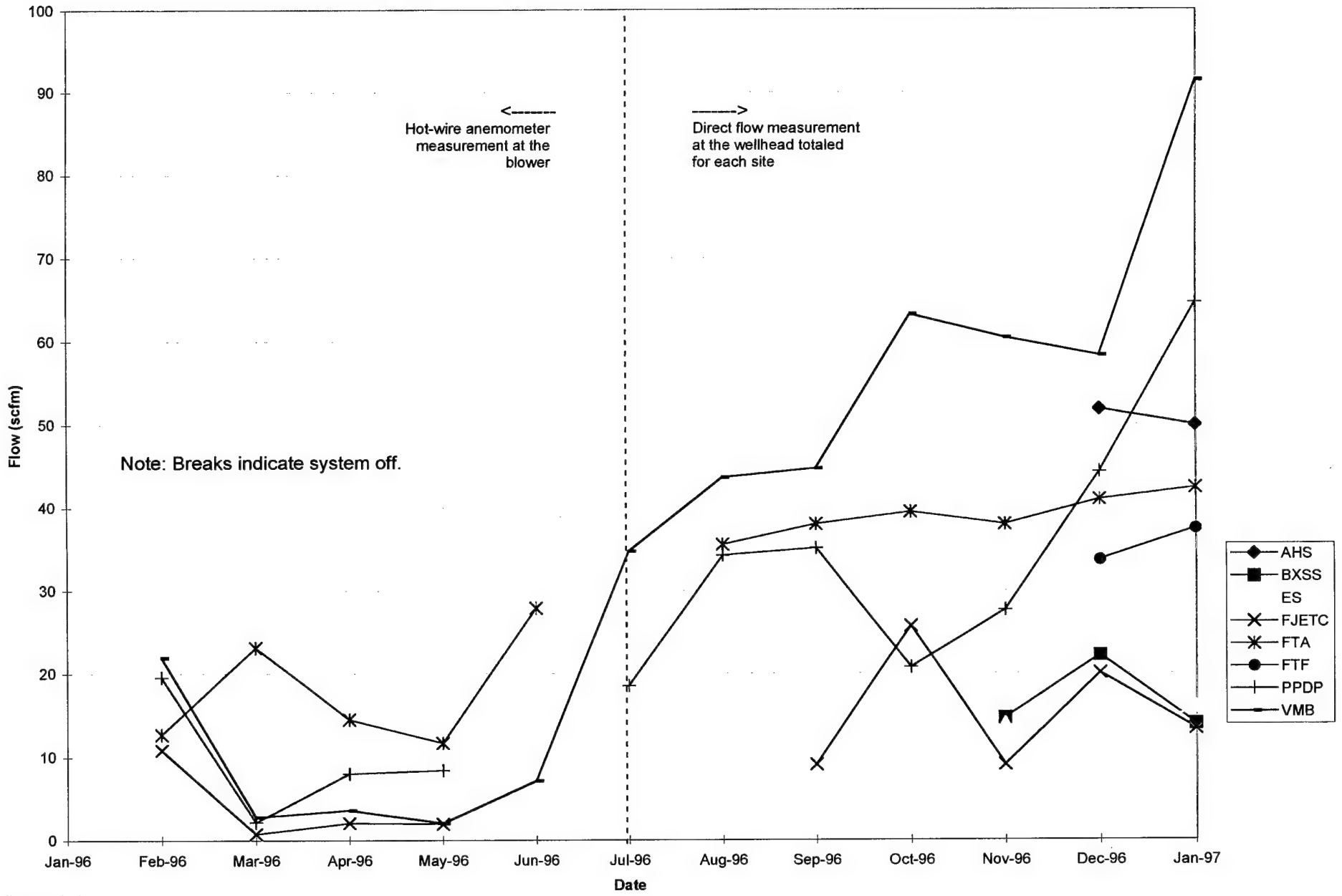

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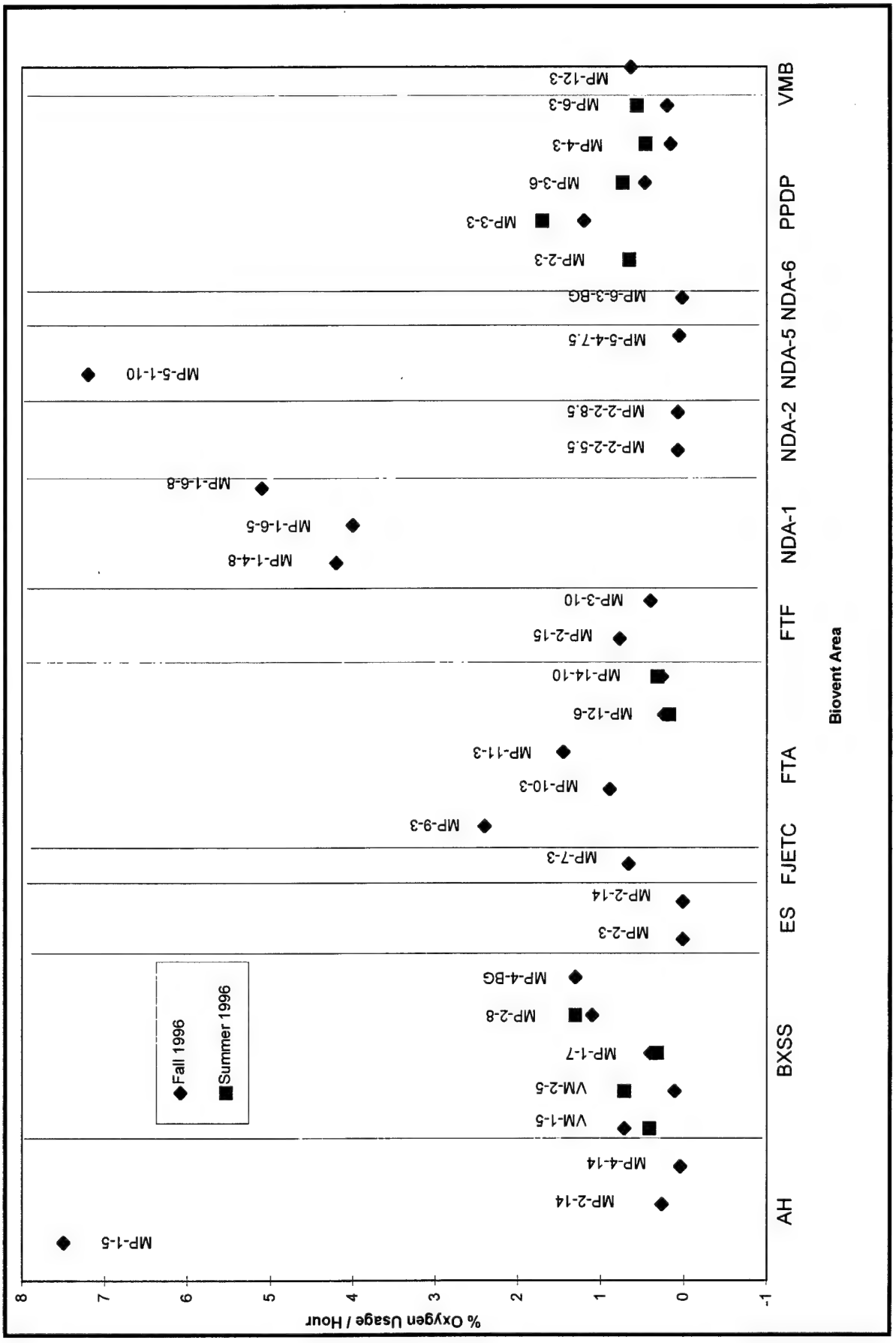
Table 3-1
Results from the Summer and Fall 1996 Respiration Testing

Site	Monitoring Point	Summer 1996 Oxygen Utilization Rate (% / hour)	Fall 1996 Oxygen Utilization Rate (% / hour)
AHS	MP-1-5	Not installed	7.5
	MP-2-14	Not installed	0.26
	MP-4-14	Not installed	0.04
BXSS	VM-1-5	0.41	0.71
	VM-2-5	0.71	0.11
	MP-1-7	0.32	0.4
	MP-2-8	1.3	1.1
	MP-4-BG	Not tested	1.3
ES	MP-2-3	Not installed	0.01
	MP-2-14	Not installed	0.01
FJETC	MP-7-3	Not tested	0.66
FTA	MP-9-3	Not tested	2.4
	MP-10-3	Not tested	0.89
	MP-11-3	Not tested	1.45
	MP-12-6	0.17	0.23
	MP-14-10	0.31	0.26
FTF	MP-2-15	Not installed	0.77
	MP-3-10	Not installed	0.4
NDA-1	MP-1-4-8	Not installed	4.2
	MP-1-6-5	Not installed	4
	MP-1-6-8	Not installed	5.1
NDA-2	MP-2-2-5.5	Not installed	0.07
	MP-2-2-8.5	Not installed	0.07
NDA-3	No points available for respiration testing		Not tested
NDA-4	No points available for respiration testing		Not tested
NDA -5	MP-5-1-10	Not installed	7.2
	MP-5-4-7.5	Not installed	0.05
NDA-6	MP-6-3-BG	Not installed	0.014
NDA-7	No points available for respiration testing		Not tested
NDA -8	No points available for respiration testing		Not tested
PPDP	MP-2-3	0.65	Not tested
	MP-3-3	1.7	1.2
	MP-3-6	0.73	0.46
	MP-4-3	0.45	0.15
	MP-6-3	0.56	0.19
VMB	MP-12-3	Not tested	0.63

Figure 3 - 2
Summer and Fall 1996 Respiration Test Results by Biovent Area



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Well seal leaks were minimized by limiting the injection pressure to 5 psi or less. This was successful since no previously installed seals were compromised in the past 6 months. As the winter progresses, injection pressures will be monitored more carefully to maintain sealed wells, especially during spring thaw.

Flow measurements were initially unreliable because of the method of measurement. A flow meter demonstration was performed during the summer of 1996 to evaluate different flow measuring devices. The results of the test, presented in the first semiannual report (BEI 1996e), indicated that a Dwyer® in-line rotometer provided the most accurate flow readings. All AIWs were retrofitted with these instruments and were found to work well under all conditions.

During the spring and summer, inundation of the AIWs was found to be a major inhibitor of air injection. This problem still exists and is anticipated to continue as groundwater levels seasonally fluctuate. However, if a constant pressure is applied to an AIW, air will eventually make its way into the subsurface. As spring approaches and groundwater levels rise, attention will be paid to injection pressures and flow rates. If water levels completely inundate a majority of the site's AIWs, the system will be turned off until groundwater levels subside.

Soil gas samples have generally been difficult to collect. Several factors may account for this: well point being screened in tight soil, point inundated, screen clogged or tubing compromised, or frozen tubing (winter months). No method for improving the collection of soil gas samples from the existing points has been found. However BEI continues to monitor the points each month since unexplained improvements do occur. In the site-specific sections that follow, new MPs will be recommended for installation where improvement in the operation of current MPs is not believed possible. For future installations, split spoon samples should be taken during installation, with the MP screen installed in a permeable zone, not at predetermined depths.

O&M of the biovent systems will continue through the winter as they have over the past several months. As warmer weather approaches and spring thaw begins, attention will be focused on water levels and the pressures required to maintain air injection. Monitoring of the oxygen sensors will begin in February, with the data being presented in the monthly reports. No monitoring of the existing MPs will be done until nonfreezing conditions exist.

The next round of respiration tests are scheduled for June and July 1997. The tests will include all MPs for which tests have been performed in the past and additional MPs at sites where no respiration tests have yet been performed. MP selection will be also based on the ability to collect soil gas samples.

Evaluations and recommendations for each site are discussed in each of the site-specific sections that follow. A summary of the recommendations in the subsequent sections is provided in Table 3-2.

Table 3-2
Summary of Site-Specific Recommendations

Site	Recommendation
AHS	Verify that background MP-5 lies within uncontaminated soils. No change to system recommended.
BXSS	Increase air flow into BV wells during summer months, not to exceed design rate. Verify extent of contamination in background area (MP-4).
ES	Install new MP near former ES basement slab. Install oxygen sensors in new MP, MP-1, and MP-4 (at depth).
FJETC	Replacement AIWs and additional MPs are suggested in the northern section of FJETC. Investigative sampling to verify contamination, saturation levels, and permeable zones is recommended to determine whether installation of AIWs and MPs or excavation should be pursued.
FTA	No changes to system are recommended.
FTF	Increase air flow into BVs 3, 4, and 14 and BSs 5 and 7. Include BS16 in biovent system mode.
NDAs	Long-term performance has yet to be determined. Four areas not accepting air will be considered for alternative remedial action if air cannot be injected during the spring and summer months.
PPDP	Install oxygen sensor in MP-1. Install new MP or collect soil samples in the north-central portion of the site (no MPs in area).
VMB	Run system as is through spring. Collect confirmation soil samples.

3.3 AUTO HOBBY SHOP

3.3.1 Operations

The AHS, located in OU 9, consists of 19 AIWs and 18 MPs installed in 8 MP locations (some locations containing multiple points screened at distinct depths) (Figure 3-3). Four of the 19 MPs contain oxygen sensors. This system was installed by COE, with operations initiated in the fall of 1996. It has operated for a total of 94 days through January 1997.

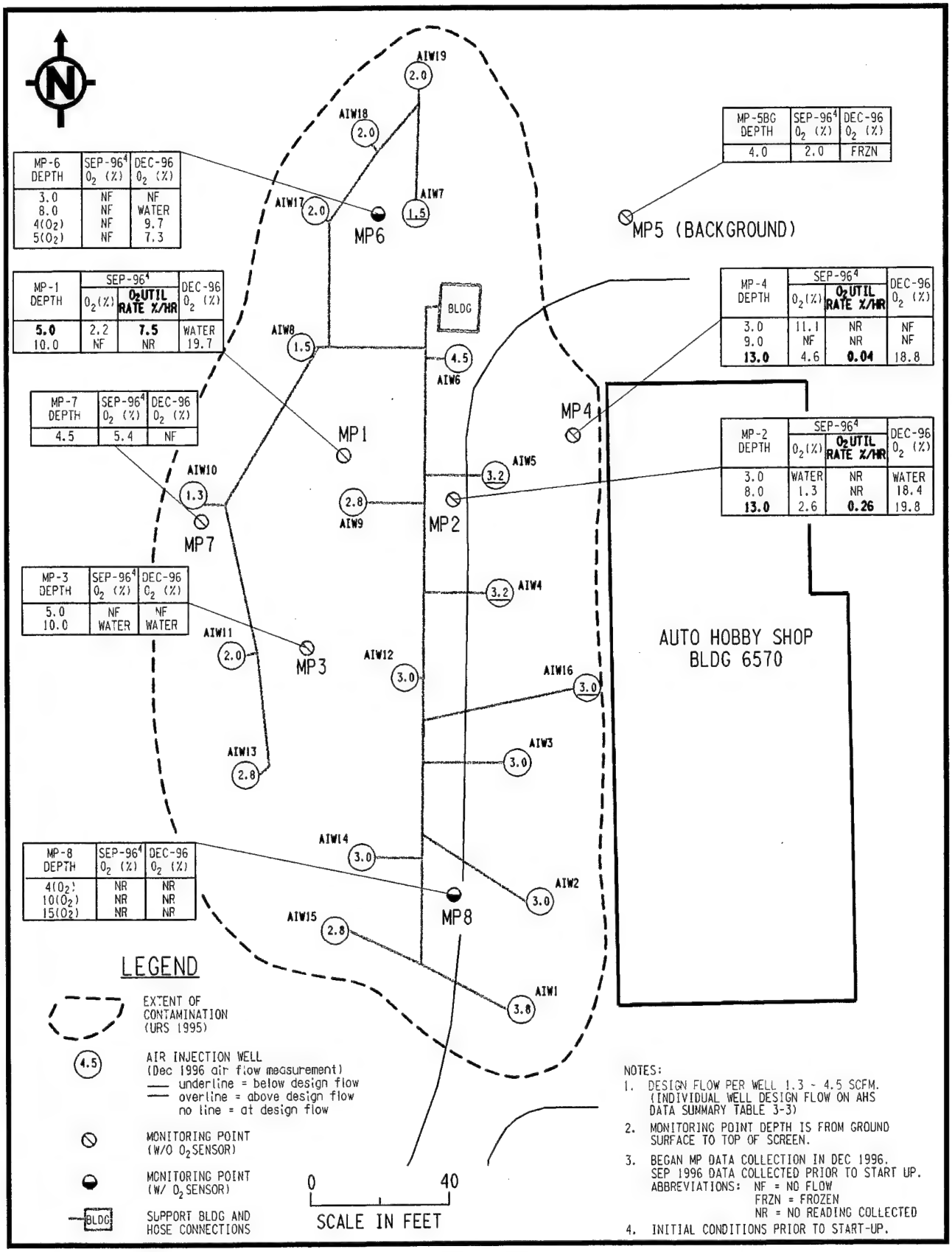
Individual AIW flow data are presented in Table 3-3 for the AHS bioventing system. Measurements taken after startup show all wells were accepting air at or near design flow rates, with an average rate of 2.6 scfm. The flow resulted in an increase in oxygen levels in several of the MPs. September 1996 respiration test results, shown in Figure 3-4, reveal a range of respiration rates. The values range from 7.5 percent/hr (highest measured at Loring AFB) to 0.04 percent/hr (indicative of background or uncontaminated soils).

3.3.2 Conclusions and Recommendations

All 19 AIWs at the AHS are accepting flow at or slightly less than the design flow rate (see Figure 3-3). Only two of the five oxygen sensor results were collected due to inaccessible conditions at MP-8, which contained three oxygen sensors. Therefore no information on soil gas was attained in the southern portion of the site. Since all AIWs are at design flow, no action is recommended in this area until oxygen data have been recorded.

Although the western side of the site is accepting air at design levels, monitoring data could not be obtained from MP-3 and MP-7 in December 1996 due to the presence of water or frozen conditions. A soil gas sample collected in MP-7 in September 1996 indicated biodegradation was occurring. A minimum of one functional MP is recommended for this area. Assuming MP-7 is usable in the non-winter months, no changes to the system are suggested along the western side of AHS. If the soil-gas sampling events starting in spring 1997 show that these MPs remain unusable, installation of one new monitoring point between MP-3 and MP-7 is suggested. The new MP will be installed within the greatest permeable zone between 4 and 15 ft below ground surface (bgs) as determined in the field.

An oxygen utilization rate of 0.04 percent/hr in MP-4 is suggestive of background conditions. The flow rate into nearby AIWs (AIWs 5–16) can be reduced if oxygen levels in MP 1 and MP 2 remain high. Otherwise if MP 1 and MP 2 oxygen levels fall below 5 percent the flow to AIWs 5 and 6 will be kept at current rate. In the center of the AHS site, MP-1, MP-2, and MP-4 soil gas data indicate that oxygen content is high (18.4 to 19.7 percent) and carbon dioxide and TVH levels are low. These results, when compared to initial conditions measured in September 1996, suggest oxygen consumption levels slowed substantially due to the colder temperatures in December. An oxygen utilization rate of 7.5 percent/hr measured in MP-1 is high relative to rates measured at other sites at Loring. Oxygen utilization rate will be measured in the summer and are expected to decrease. The oxygen utilization rate determined in MP-2 (0.26 percent/hr) indicates



MP-6 DEPTH	SEP-96[4] O_2 (%)	DEC-96 O_2 (%)
3.0	NF	NF
8.0	NF	WATER
4(O_2)	NF	9.7
5(O_2)	NF	7.3

MP-5BG DEPTH	SEP-96[4] O_2 (%)	DEC-96 O_2 (%)
4.0	2.0	FRZN

MP-1 DEPTH	SEP-96[4]		DEC-96
	O_2(%)	O_2UTIL RATE %/HR	O_2 (%)
5.0	2.2	**7.5**	WATER
10.0	NF	NR	19.7

MP-4 DEPTH	SEP-96[4]		DEC-96
	O_2(%)	O_2UTIL RATE %/HR	O_2 (%)
3.0	11.1	NR	NF
9.0	NF	NR	NF
13.0	4.6	**0.04**	18.8

MP-7 DEPTH	SEP-96[4] O_2 (%)	DEC-96 O_2 (%)
4.5	5.4	NF

MP-2 DEPTH	SEP-96[4]		DEC-96
	O_2(%)	O_2UTIL RATE %/HR	O_2 (%)
3.0	WATER	NR	WATER
8.0	1.3	NR	18.4
13.0	2.6	**0.26**	19.8

MP-3 DEPTH	SEP-96[4] O_2 (%)	DEC-96 O_2 (%)
5.0	NF	NF
10.0	WATER	WATER

MP-8 DEPTH	SEP-96[4] O_2 (%)	DEC-96 O_2 (%)
4(O_2)	NR	NR
10(O_2)	NR	NR
15(O_2)	NR	NR

22784/043/FIG2-3.DGN

Figure 3-3
AHS Biovent System Layout and Well Head Flow (Dec 1996 Air Flow)

Table 3 - 3 AHS Air Flow and Monitoring Point Data

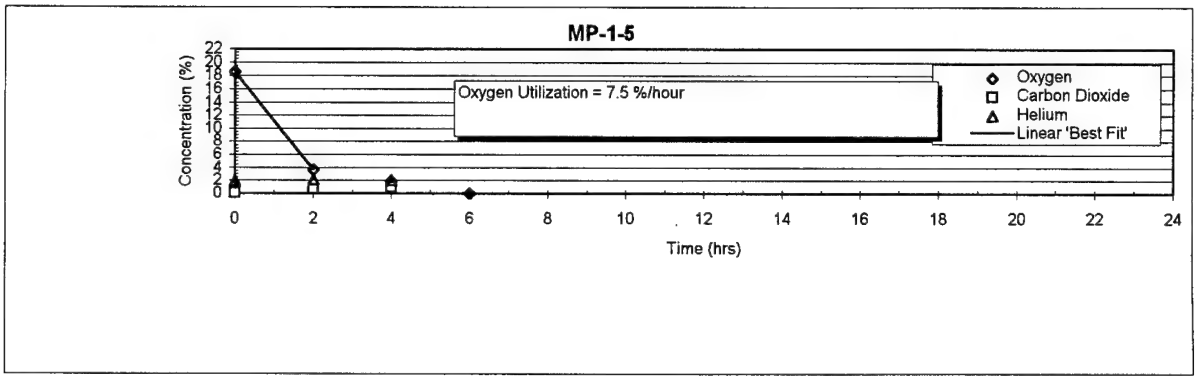
Air Injection Well	Screen Interval top[4]	Screen Interval bottom[4]	Overburden Pressure[1] (psi)	Design Air Flow (scfm)	Individual Well Head Flow (scfm) September 1996	October 1996	November 1996	December 1996	January 1997
AIW-1	14	21	9.7	3.8	System startup Dec. 1996	System startup Dec. 1996	System startup Dec. 1996	3.8	3.8
AIW-2	15	22	10.4	3.0				3.0	3.0
AIW-3	15	22	10.4	3.0				3.0	3.0
AIW-4	14	22	9.7	3.8				3.2	3.8
AIW-5	13	21	9.0	3.8				3.2	3.8
AIW-6	13	20	9.0	4.5				4.5	1.4
AIW-7	8	15	5.6	3.0				3.0	3.0
AIW-8	6	13	4.2	1.5				1.5	1.5
AIW-9	10	17	6.9	2.8				2.8	2.8
AIW-10	6	10	4.2	1.3				1.3	1.3
AIW-11	7	14	4.9	2.0				2.0	2.0
AIW-12	12	19	8.3	3.0				3.0	3.0
AIW-13	8	15	5.6	2.8				2.8	2.8
AIW-14	11	18	7.6	3.0				3.0	3.0
AIW-15	9	16	6.3	2.8				2.8	2.8
AIW-16	15	23	10.4	3.8				3.0	3.0
AIW-17	5	10	3.5	2.0				2.0	2.0
AIW-18	6	11	4.2	2.0				2.0	2.0
AIW-19	7	12	4.9	2.0				2.0	2.0
Total air flow:				53.9				51.9	50.0
Blower Information									
Date:								12/11/96	1/9/97
Time:								1230	0730
Exit Temperature (°F):								63	30
Pressure (psi):								3.7	2.3

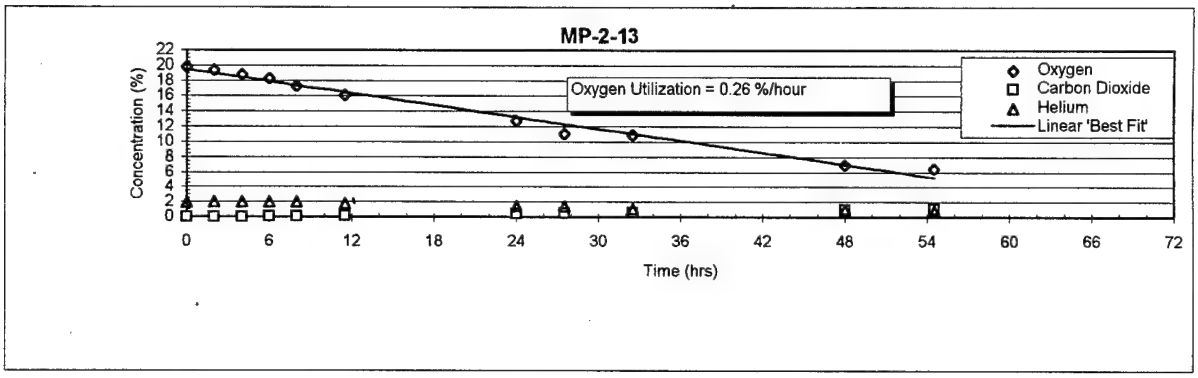
Monitoring Point	Screen Interval (ft bgs) top	bottom	Notes	Soil Gas Sampling Results September 1996[3] O (%)	CO (%)	TVH (ppmv)	October 1996 O (%)	CO (%)	TVH (ppmv)	November 1996 O (%)	CO (%)	TVH (ppmv)	December 1996 O (%)[2]	CO (%)	TVH (ppmv)	January 1997 O (%)[2]	CO (%)	TVH (ppmv)
MP-1-5	5	5.5	O_2 Util. Rate = 7.5%/hr[5]	2.2	7.9	>10000	System startup Dec. 1996			System startup Dec. 1996				Water in line			Frozen	
MP-1-10	10	10.5			No flow								19.7	0.0	4.0		Frozen	
MP-2-3	3	3.5			Water in line									Water in line			Frozen	
MP-2-8	8	8.5		1.3	11.8	500+							18.4	1.3	1.0		Frozen	
MP2-13	13	13.5	O_2 Util. Rate = 0.26%/hr[5]	2.6	11.5	500+							19.8	0.0	1.0		Frozen	
MP-3-5	5	5.5			No flow									No flow			Frozen	
MP-3-10	10	10.5			Water in line									Water in line			Frozen	
MP-4-3	3	3.5		11.1	8.1	550.0								No flow			Frozen	
MP-4-9	9	9.5			No flow									No flow			Frozen	
MP4-13	13	13.5	O_2 Util. Rate = 0.04%/hr[5]	4.6	14.4	3.0							18.8	0.9	2.0		Frozen	
MP-5BG-4	4	9	Background location	2.0	20	>10000								Frozen			Frozen	
MP-6-3	3	3.5			No flow									No flow			Frozen	
MP-6-8	8	8.5			No flow									Water in line			Frozen	
MP-6-4	4	4.5	O_2 Sensor - On 12/10/96										9.7	na	na	18.0	na	na
MP-6-5	5	5.5	O_2 Sensor - On 12/10/96										7.3	na	na	10.7	na	na
MP 7-4.5	4.5	5		5.4	11.2	>10000								No flow			Frozen	
MP-8-4	4	4.5	O_2 Sensor - On 12/10/96										nr	na	na	nr	na	na
MP-8-10	10	10.5	O_2 Sensor - On 12/10/96										nr	na	na	nr	na	na
MP-8-15	15	15.5	O_2 Sensor - On 12/10/96										nr	na	na	nr	na	na

[1] Maximum pressure before potential for fracturing of soil. Conservative value calculated at top of screen assuming density of soil is 100 lbs/ft^3.
[2] The monthly O_2 sensor results is the average for month. See biovent monthly reports for daily values.
[3] Initial conditions, prior to startup.
[4] Measured from top of casing.
[5] Test performed on 9/29/96.
bgs = below ground surface, nr = no reading, inaccessible, na = not applicable

Time[1]	MP-1-5				MP-2-13				MP-4-13			
(hrs)	O_2	CO_2	TVH	Helium	O_2	CO_2	TVH	Helium	O_2	CO_2	TVH	Helium
0	18.6	0.1	48	1.9	19.8	0.0	3	1.9	19.9	0.0	3	1.9
2	3.7	0.7		2.1	19.4	0.0	2	2.0	19.8	0.0	7	2.0
4	1.9	1.0		2.0	18.8	0.0	3	2.0	20.0	0.0	4	1.9
6		End of Test			18.3	0.1	4	2.0	20.6	0.1	3	1.5
8					17.3	0.1		2.0	20.0	0.1	3	1.8
11.5					16.1	0.2	1	1.8	19.8	0.2	3	1.2
24					12.8	0.4	2	1.4	19.5	0.5	4	1.6
27.5					11.1	0.5	4	1.4	18.9	0.5	5	1.4
32.5					10.9	0.6	7	1.1	18.8	0.7	8	1.3
48					7	1		1	18.1	1.1	4	1.1
54.5					6.5	1.1		0.84	17.6	1.2	5	1.1
76						End of Test			16.8	1.4	27	0.7
174.5									13.8	2.8		0.3

[1] Test began on 9/29/96 at 08:00





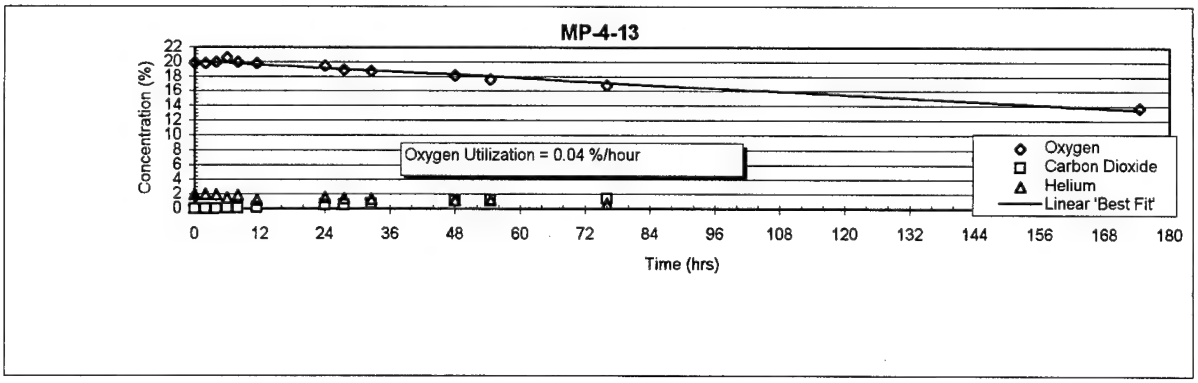


Figure 3 - 4 Pre-startup Respiration Test Results for MP-1-5, MP-2-13, and MP-4-13 at the Auto Hobby Shop

biodegradation is within a range typically associated with active biodegradation (i.e., 0.1 to 1.04 percent/hr). No change in the current operations are suggested in the center of the site.

The oxygen sensor in MP-6 suggests that degradation is occurring since most surrounding AIWs are supplying sufficient air and the oxygen level in MP-6 is greater than 5 percent but less than 10 percent. No change to this area is recommended.

The background MP-5 appears to be located in a potentially contaminated area based on the high TVH level (>10,000 ppmv), high carbon dioxide level, and low oxygen level. These measurements were collected in September 1996, before system startup in December; therefore, current levels need to be investigated. Unfortunately, MP-5 was frozen in December and January. If these conditions persist in the spring, this area of the site will need to be investigated to determine whether the extent of contamination extends to this area. If contamination is confirmed outside the extent of the bioventing system, a determination will be made whether to expand the system or excavate the contaminated soils for disposal at Landfill 3.

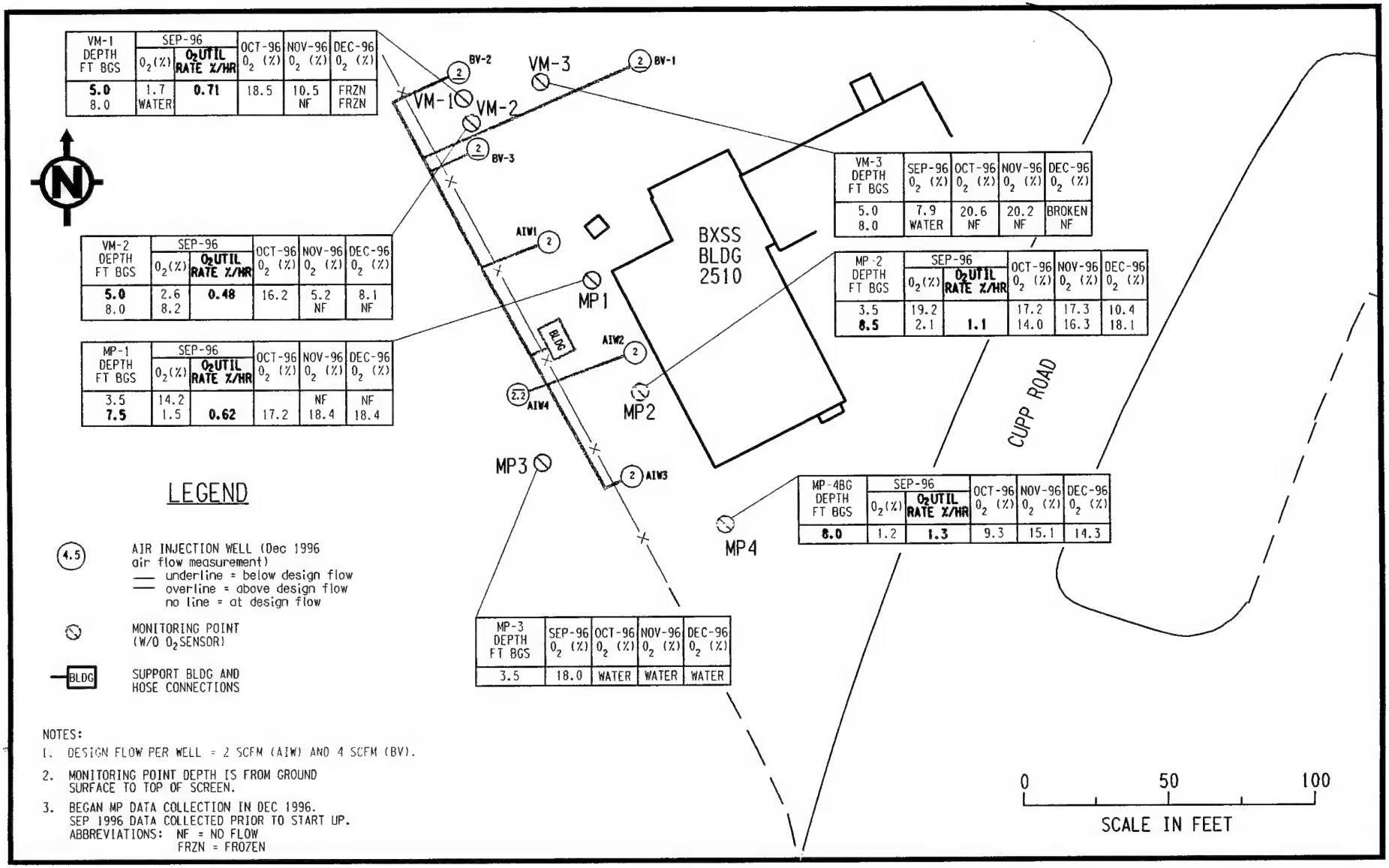
Overall Recommendation for AHS: The majority of the site is operating per design and most MPs are providing data. Only MP-3 appears to be a problem due to the fact that soil gas samples could not be collected from both intervals in MP-3. If both MP-7 and MP-3 become unusable in the spring and summer months, a replacement MP will be needed in the western area of the site. Otherwise, MP-7 should be sufficient for monitoring the western portion of the site. No operational changes to the airflow settings or improvements to MPs are recommended for the AHS site at this time. An investigation of possible contaminants in the background area is suggested. If background measurements in the spring of 1997 continue to produce low oxygen, high carbon dioxide, and high TVH, it is suggested that a respiration test be run in MP 5. If the oxygen utilization rate is > 0.1 percent/hr, approximately three to five soil sampling locations will be needed in this area to confirm and delineate contamination.

3.4 BASE EXCHANGE SERVICE STATION

3.4.1 Operations

The BXSS, located in OU 5, consists of 7 AIWs and 12 MPs (Figure 3-5). The BXSS biovent system was originally installed in the fall of 1993 (Earth Tech 1995) and consisted of three AIWs and six MPs (designated as biovent points, or BV). During the summer/fall of 1996, four additional AIWs and six MPs were installed. Startup of the newly expanded system was in October 1996. Since BEI assumed O&M responsibilities in February 1995, the BXSS system has operated 301 days.

Individual AIW airflow data for the BXSS bioventing system is presented in Table 3-4. No measurements were taken during September and October due to respiration testing and construction activities associated with the system enhancement. Flows measured subsequently show that each AIW was injecting at the design flow of 2 cfm. The BV injection wells were operated between 2 scfm and their design flow rate of 4 scfm.



22784/043/FIG2-5.DGN

Figure 3-5
BXSS Biovent System Layout and Well Head Flow (Dec 1996 Comparison)

Table 3 - 4 BXSS Air Flow and Monitoring Point Data

Air Injection Well	Screen Interval ft/bgs top[5]	bottom[5]	Overburden Pressure[1] (psi)	Design Air Flow (scfm)	Individual Well Head Flow (scfm) September 1996[2]	October 1996[2]	November 1996	December 1996	January 1997
BV-1	9.3	29.5	6.5	4		nr	2.0	4.0	2.0
BV-2	8.3	28.4	5.8	4		nr	4.0	3.0	2.0
BV-3	5.5	25.7	3.8	4		nr	2.0	5.0	2.0
AIW-1	7	12	4.9	2		nr	2.5	2.0	2.0
AIW-2	9	14	6.3	2		nr	2.0	2.0	2.0
AIW-3	8	13	5.6	2		nr	nr	2.0	2.0
AIW-4	6	11	4.2	2		nr	2.2	2.2	2.0
Total air flow:				20			14.7	20.2	14.0
Blower Information									
Date:						nr	11/22/96	12/11/96	1/6/97
Time:						nr	1450	1055	1400
Exit Temperature (°F):						nr	142.1	131.5	132.8
Pressure (psi):						nr	1.8	1.9	1.9

Monitoring Point	Screen Interval (ft bgs) top	bottom		Soil Gas Sampling Results: September 1996[3] O (%)	CO (%)	TVH (ppmv)	October 1996 O (%)	CO (%)	TVH (ppmv)	November 1996 O (%)	CO (%)	TVH (ppmv)	December 1996 O (%)	CO (%)	TVH (ppmv)	January 1997 O (%)	CO (%)	TVH (ppmv)
VM-1-5	5	5.5	O_2 Util. Rate = 0.71%/hr[5]	1.7	15.7	1200	18.5	1.4	185	10.5	7.6	2.6[4]		Frozen			Water - frozen	
VM-1-8	8	8.5			Water			No flow			No flow			Frozen			Water - frozen	
VM-2-5	5	5.5	O_2 Util. Rate = 0.48%/hr[5]	2.6	9.7	40	16.2	4.4	201	5.2	13.3	4[4]	8.1	9.4			Water - frozen	
VM-2-8	8	8.5		8.2	2.0	900		No flow			No flow			No flow			Water - frozen	
VM-3-5	5	5.5		7.9	1.0	10	20.6	0.0	2	20.2	0.0	2		Line broken			Water - frozen	
VM-3-8	8	8.5			Water			No flow			No flow			No flow			Water - frozen	
MP-1-3.5	3.5	4		14.2	4.5	800		No flow			No flow			No flow			Water - frozen	
MP-1-7.5	7.5	8	O_2 Util. Rate = 0.62%/hr[5]	1.5	12.5	>10000	17.2	3.2	20	18.4	1.5	9	18.4	1.0	7		Water - frozen	
MP-2-3.5	3.5	4		19.2	0.7	10	17.2	0.5	91	17.3	0.5	2.3	10.4	4.8			Water - frozen	
MP-2-8.5	8.5	9	O_2 Util. Rate = 1.1%/hr[6]	2.1	11.6	>10000	14.0	5.5	961	16.3	3.3	42	18.1	1.2	22		Water - frozen	
MP-3-3.5	3.5	4		18.0	1.9	1350		Water in line			Water in line			Water in line			Water - frozen	
MP-4BG-8	8	8.5	O_2 Util. Rate = 1.3%/hr[5]	1.2	17.5	>10000	9.3	7.9		15.1	2.9	77	14.3	3.0	490		Water - frozen	

[1] Maximum pressure before potential for fracturing of soil. Calculated at top of screen assuming density of soil is 100 lbs/ft^3.
[2] System down due to the installation of additional wells and respiration testing. System turned on 10/8/96.
[3] System down, samples taken prior to respiration testing.
[4] TVH reading taken with Photo Ionization Detector.
[5] Measured from top of casing in AIW wells only. Otherwise measured from ground surface.
[6] Test performed on 9/30/96.
bgs = below ground surface, nr = no reading

Oxygen levels at the monitoring locations during operational periods were above 5 percent, with vapor monitoring point (VM)-2-5 having the lowest oxygen level at 5.2 percent (Table 3-4). Oxygen utilization rates were measured at all of the monitoring locations (MPs and VM locations). The oxygen utilization rates are shown in Figures 3-6 and 3-7. During the month of November 1996 the majority of monitoring points were functioning, although each of the deep intervals (8–8.5 ft bgs) in the VM points had no flow. Conversely, the shallow intervals (3.5–4 ft bgs) in MP 1 and MP 3 were unusable because of no flow and water innundation, respectively. Seven of the 12 monitoring locations were unusable in December, with all the wells being frozen in January.

3.4.2 Conclusions and Recommendations

The background point, MP-4BG, had an initially low oxygen level. A respiration test was run on this point and the oxygen utilization rate was calculated to be 1.3 percent/hr (Figure 3-7). This would indicate that the point is screened in contaminated soil and that biodegradation is transpiring. Since startup, the oxygen level at MP-4BG has also increased, showing that aeration is occurring in this region, and that this should not be considered a background MP.

In general, oxygen levels have increased in MPs since samples were initially taken in September 1996. Since system startup in October 1996 aeration of the majority of the contaminated area has been successful. Water levels have remained high in the area where the original BV wells were installed; thus, aeration may not be occurring at depth in this area. Oxygen levels have confirmed aeration in the shallower interval in this area. Oxygen utilization rates were measured at each of the MPs. An oxygen utilization range typically associated with enhanced biodegradation was noted. The oxygen utilization rates ranged from a minimum of 0.48 percent/hr at VM-2-5 to a maximum of 1.3 percent/hr at the background location MP-4BG-8.

Overall Recommendation for BXSS: Air injection rates into the BV wells are typically below design, although aeration of the shallow intervals is occurring. During the summer months the air injection rate will be kept closer to the design flow rate in the BV wells in order to maximize the potential for aeration of the deeper intervals. No changes are recommended to the remaining system. If background measurements (MP-4BG) collected in the spring and summer of 1997 continue to produce high carbon dioxide and TVH and a high oxygen utilization rate, it is suggested that approximately three to five soil sampling locations be identified to approximate the extent of contamination in this area.

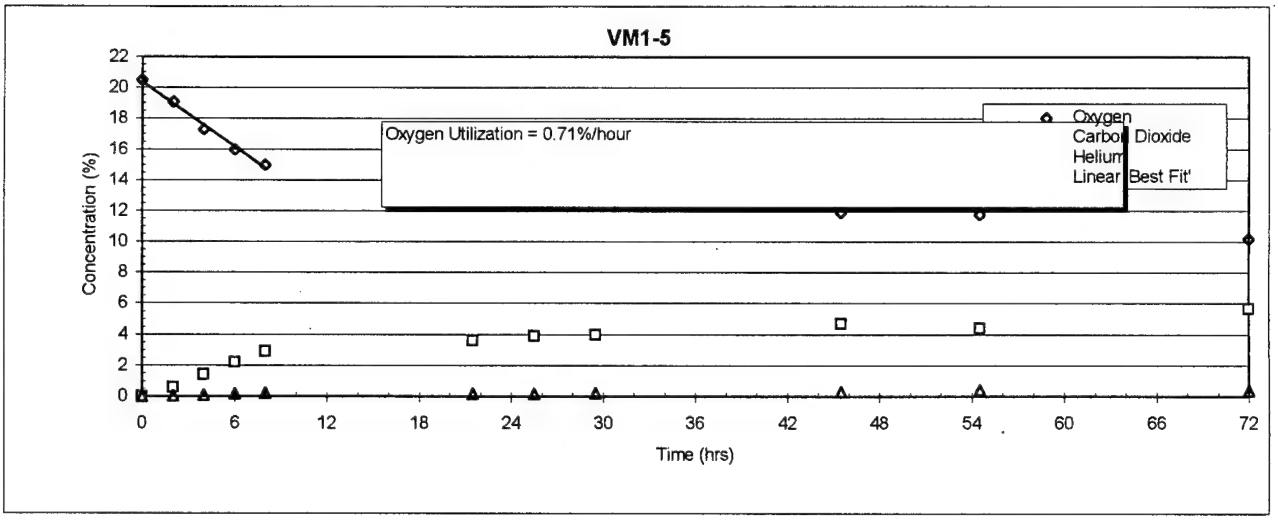
3.5 ENTOMOLOGY SHOP

3.5.1 Operations

The ES, located in OU 10, consists of 7 AIWs and 10 MPs (Figure 3-8). The ES biovent system was installed by BEI in the summer of 1996 and started up in September 1996, with O&M beginning in October. The system has operated 122 days.

Time[1]	VM1-5				VM2-5			
(hrs)	O_2	CO_2	TVH	Helium	O_2	CO_2	TVH	Helium
0	20.5	0.0	99	0.0	20.4	0.0	208	0.1
2	19.1	0.6	397	0.1	18.5	0.8	944	0.1
4	17.3	1.4	840	0.1	17.4	1.3	1320	0.1
6	16.0	2.2	1300	0.2	16.6	1.8	2100	0.2
8	15.0	2.9	1400	0.2	16.5	1.9	1800	0.2
21.5	14.0	3.6	575	0.2	15.6	2.4	325	0.2
25.5	12.8	3.9	608	0.2	14.5	2.6	381	0.2
29.5	12.8	4		0.2	13.6	2.7		0.3
45.5	11.9	4.7	260	0.3	12.6	3.2	120	0.4
54.5	11.8	4.4	330	0.4	11.8	3.4	133	0.5
72	10.2	5.7	225	0.4	9.4	4.7	35	0.5
95.5	9.8	5.4	50	0.6	7.9	4.9		0.7

[1] Test began on 9/30/96 at 10:00



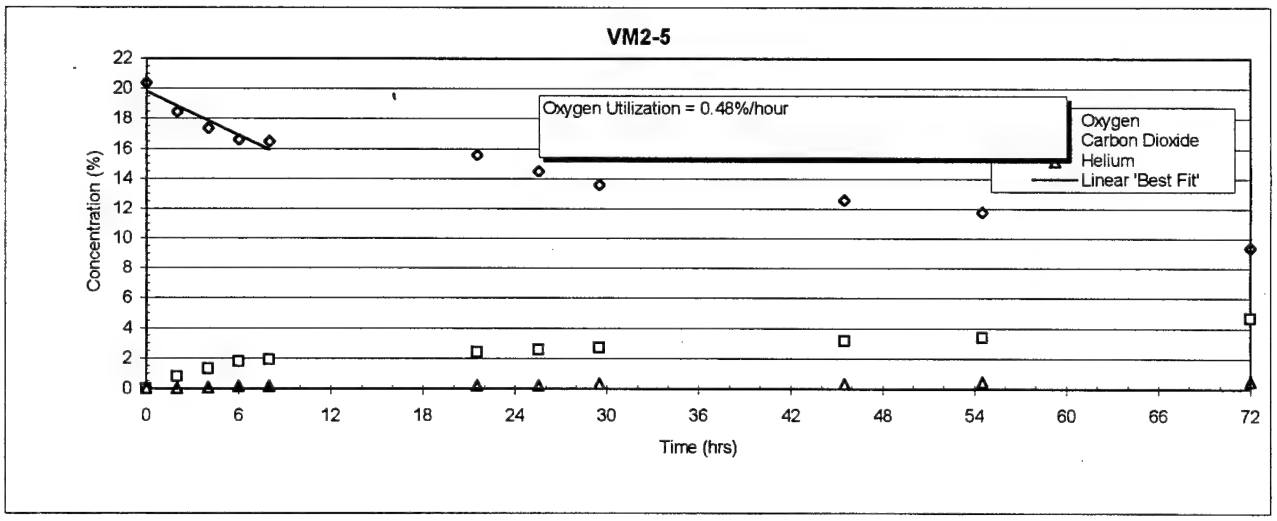


Figure 3 - 6 Fall 1996 Respiration Test Results for VM-1-5 and VM-2-5 at the Base Exchange Service Station

Time[1]	MP-1-7.5				MP-2-8.5				MP-4BG-8 (Background)			
(hrs)	O_2	CO_2	TVH	Helium	O_2	CO_2	TVH	Helium	O_2	CO_2	TVH	Helium
0	20.0	0.0	9	2.8	20.0	0.0	115	2.4	20.1	0.0	42	2.6
2	18.8	0.1	63	1.6	16.6	0.3	820	2.1	18.1	0.2	1620	2.1
4	17.0	0.3	131	2.2	14.5	0.6	1680	2.7	16.3	0.3	2450	2.6
6	15.7	0.4	181	2.3	12.8	0.8	1720	2.3	13.0	0.6	4000	2.7
8	15.0	0.4	190	2.5	12.0	0.9	2100	2.3	10.2	1.0	5000	2.6
10	13.9	0.5	150	2.6	10.7	1.2	1800	2.3	9.2	1.1		2.3
13					9.4	1.2		2.2	6.3	1.4		2.6
23.5	8.9	1.1	55	2.0	4.9	2.3		2.2	3.9	2.4		2.4
27.5	7.7	1.2		2.3		End of test				End of test		
31.5	7.2	1.3		1.9								
46.5	4.8	1.8		1.8								

[1] Test began on 9/29/96 at 08:00

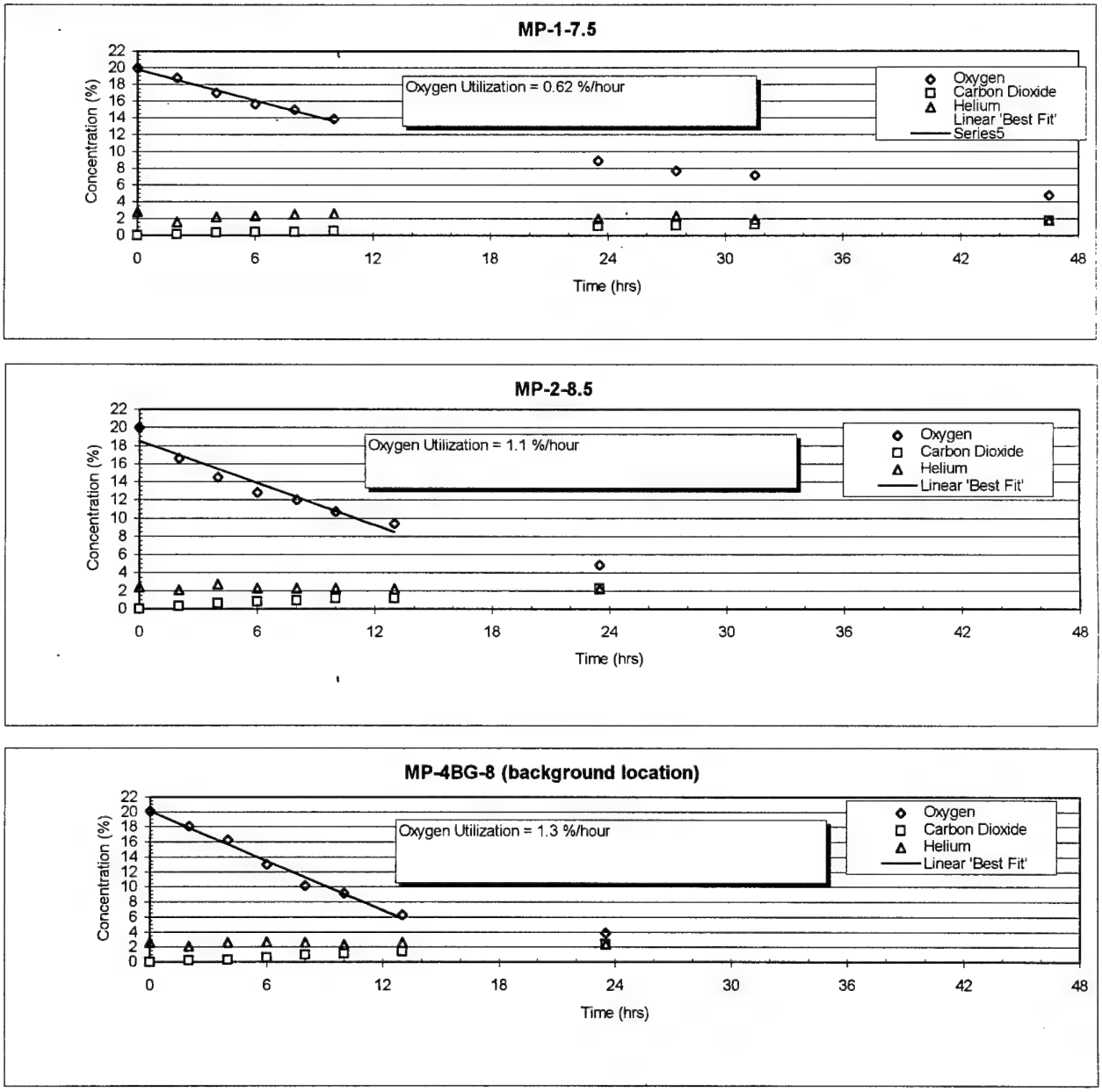
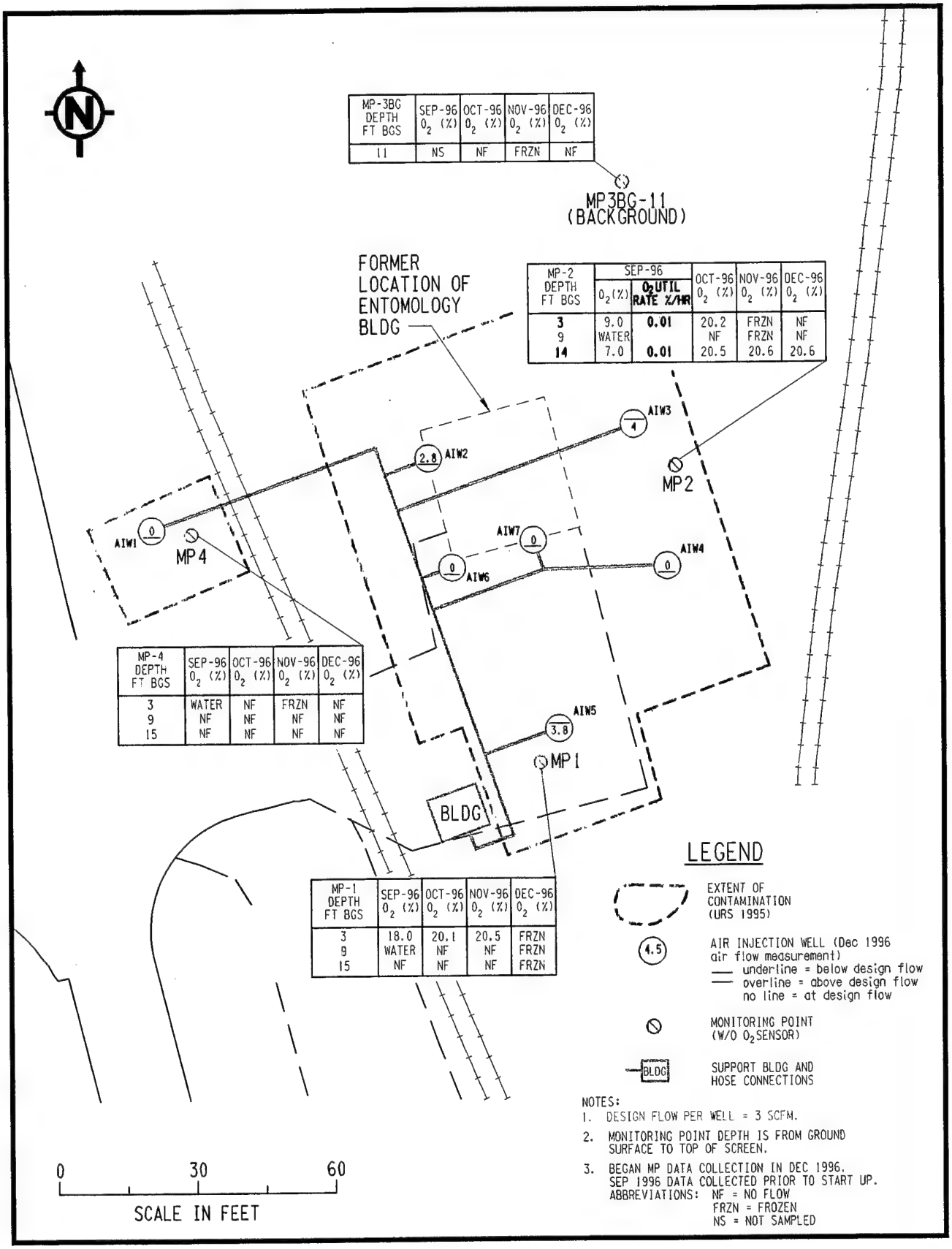


Figure 3 - 7 Pre-Startup Respiration Test Results for MP-1-7.5, MP-2-8.5 and MP-4BG-8 at the Base Exchange Service Station



22784/043/FIG2-7.DGN

Figure 3-8
ES Biovent System Layout and Well Head Flow (Dec 1996 Air Flow)

Out of the seven AIWs, three have continuously accepted air at the design flow (3 cfm), with another AIW accepting flow in November and January (Table 3-5). Only three of the ten MPs have been able to supply soil gas samples.

3.5.2 Conclusions and Recommendations

Soil gas sampling indicates that all points are being aerated; however, respiration tests performed at MP-2-3 and MP-2-14 had calculated oxygen utilization rates of 0.01 percent/hr, typical of background (Figure 3-9). MPs, other than MP-2-3 and MP-2-14, either had initially high oxygen levels or were unable to produce soil gas samples. Water inundation appears to occur in the MP-1 and MP-4 areas.

Overall Recommendation for ES: To demonstrate the functionality of the system, the *Bioventing Removal Action Report Addendum 1* (BEI 1997) recommended including an additional MP to measure biodegradation rates at the ES. This MP is to be located near the former ES basement slab, where contamination was detected during excavation activities. Oxygen sensors are suggested for installation in the new MP and at depth (i.e., 8-10 ft bgs) in MP-1 and MP-4.

3.6 FORMER JET ENGINE TEST CELL

3.6.1 Operations

The FJETC, located in OU 5, consists of 13 AIWs and 7 MPs (Figure 3-10). The FJETC biovent system was installed by BEI in the fall of 1995. Since BEI assumed responsibility for the O&M, this biovent system has operated 222 days. This system was down during portions of the summer and into early fall due to high water levels, but has been operating continuously since late September. Since being turned back on, flow is consistent into the AIWs (Table 3-6), with four of the AIWs accepting most of the flow (AIWs 3, 4, 8, 10). These four AIWs have shallower screen intervals (3 to 8 ft bgs) than the other AIWs (screened from 8 to 13 ft bgs). A discontinuous layer of gravel, up to 2-ft thick, was documented during well installation at depths ranging from 5 to 8 ft bgs (BEI 1996a) and is suspected to be the dominant pathway for accepting flow. Free product was found during soil gas sampling at MP-1-4 in early summer, but has not been encountered since.

All MPs, except the background location MP-2BG, were functional at some point during the period covered in this report. High water levels limited the collection of samples from MPs 1, 3, 4, and 5 during September through November 1996, but all four locations were sampled in December 1996. A respiration test was performed at MP-7 in September 1996, as illustrated in Figure 3-11.

3.6.2 Conclusions and Recommendations

December 1996 airflow data and historic soil gas measurements are presented in Figure 3-9. Contaminated soils in the northern section of the site may not be receiving supplied air because AIWs 1, 2, 11, and 12 have no flow. A high level of oxygen noted in MP-1 suggests that air may

Table 3 - 5 Entomology Shop Air Flow and Monitoring Point Data

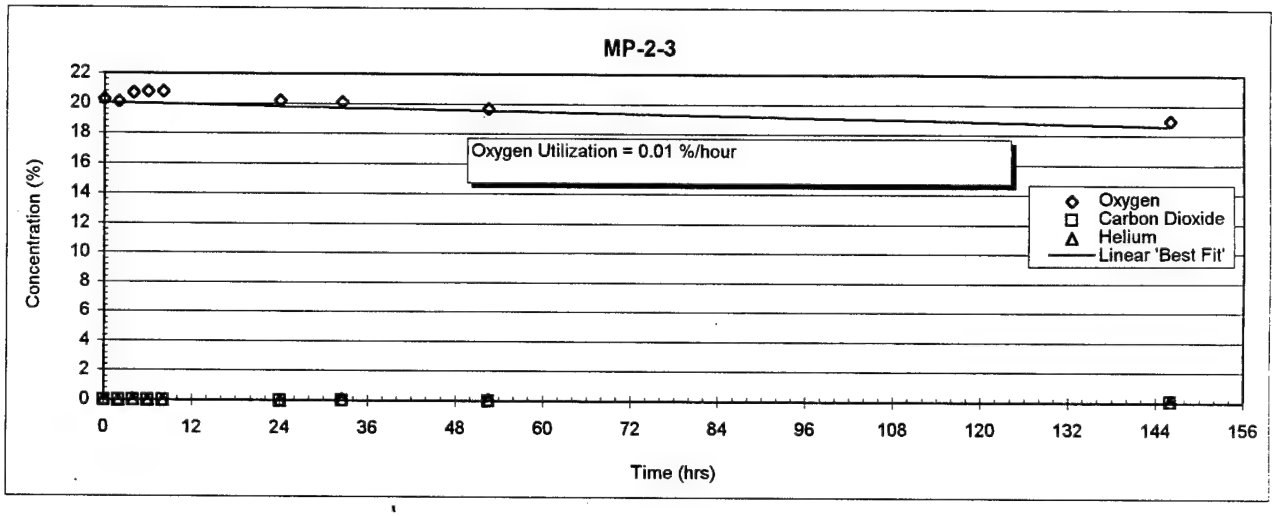
Air Injection Well	Screen Interval ft/bgs top	bottom	Overburden Pressure[1] (psi)	Design Air Flow (scfm)	Individual Well Head Flow (scfm) September 1996 [2]	October 1996	November 1996	December 1996	January 1997
AIW-1	10.3	15.3	7.2	3		0.0	0.0	0.0	0.0
AIW-2	10.1	15.1	7.0	3		3.5	3.0	2.8	4.0
AIW-3	7.5	12.5	5.2	3		4.5	4.5	4.0	4.0
AIW-4	10.1	15.1	7.0	3		0.0	0.0	0.0	0.0
AIW-5	13	18	9.0	3		2.5	5.0	3.8	4.0
AIW-6	11.4	16.4	7.9	3		0.0	1.5	0.0	4.0
AIW-7	10	15	6.9	3		0.0	0.0	0.0	0.0
Total air flow:				21		10.5	14.0	10.6	16.0
Blower Information									
Date:						10/10/96	11/14/96	12/13/96	1/10/97
Time:						1525	923	800	0930
Exit Temperature (°F):						73	58	56	56
Pressure (psi):						4.7	5	4.1	4.0

Monitoring Point	Screen Interval (ft bgs) top	bottom		Soil Gas Sampling Results: September 1996 [3] O (%)	CO (%)	TVH (ppmv)	October 1996 O (%)	CO (%)	TVH (ppmv)	November 1996 O (%)	CO (%)	TVH (ppmv)	December 1996 O (%)	CO (%)	TVH (ppmv)	January 1997 O (%)	CO (%)	TVH (ppmv)
MP-1-3	3	3.5		18.0	0.9	10	20.1	0.5	15	20.5	0	4.8		Water - frozen			Water - frozen	
MP-1-9	9	9.5			Water in line			No flow			No flow			Water - frozen			Water - frozen	
MP-1-15	15	15.5			No flow			No flow			No flow			Water - frozen			Water - frozen	
MP-2-3	3	3.5	O_2 Util. Rate = 0.01%/hr[4]	9.0	1.5	500	20.2	0.5	80		Water - frozen			No flow			Water - frozen	
MP-2-9	9	9.5			Water in line			No flow			Water - frozen			No flow			Water - frozen	
MP-2-14	14	14.5	O_2 Util. Rate = 0.01%/hr[4]	7.0	2.3	700	20.5	0.6	97	20.6	0	230	20.6	0	154		Water - frozen	
MP-3BG-11	6.5	11.5	Background location		Not sampled			No flow			Water - frozen			No flow			Water - frozen	
MP-4-3	3	3.5			Water in line			No flow			Water - frozen			No flow			Water - frozen	
MP-4-9	9	9.5			No flow			No flow			No flow			No flow			Water - frozen	
MP-4-15	15	15.5			No flow			No flow			No flow			No flow			Water - frozen	

[1] Maximum pressure before potential for fracturing of soil. Calculated at top of screen assuming density of soil is 100 lbs/ft^3.
[2] System startup in September; monthly monitoring began in October.
[3] Samples taken prior to system startup.
[4] Test performed on 9/27/96.

Time[1] (hrs)	MP-2-3				MP-2-14			
	O_2	CO_2	TVH	Helium	O_2	CO_2	TVH	Helium
0.0	20.3	0	23	0.07	20.8	0	3	0
2.0	20.1	0	17	0.01	20.1	0	17	0
4.0	20.7	0	27	0.03	20.3	0	32	0.09
6.0	20.8	0	33	0.02	20.9	0	42	0.03
8.0	20.8	0	79	0	20.8	0	68	0.01
24.0	20.2	0	43	0.02	20.5	0.1	130	0.08
32.5	20.1	0	92	0.07	20.2	0.2	160	0.16
52.5	19.7	0	103	0.1	19.8	0.3	180	0.18
146.0	19.0	0.1	266	0.11	19.0	0.4	450	0.17

[1] Test began on 9/27/96 at 08:00



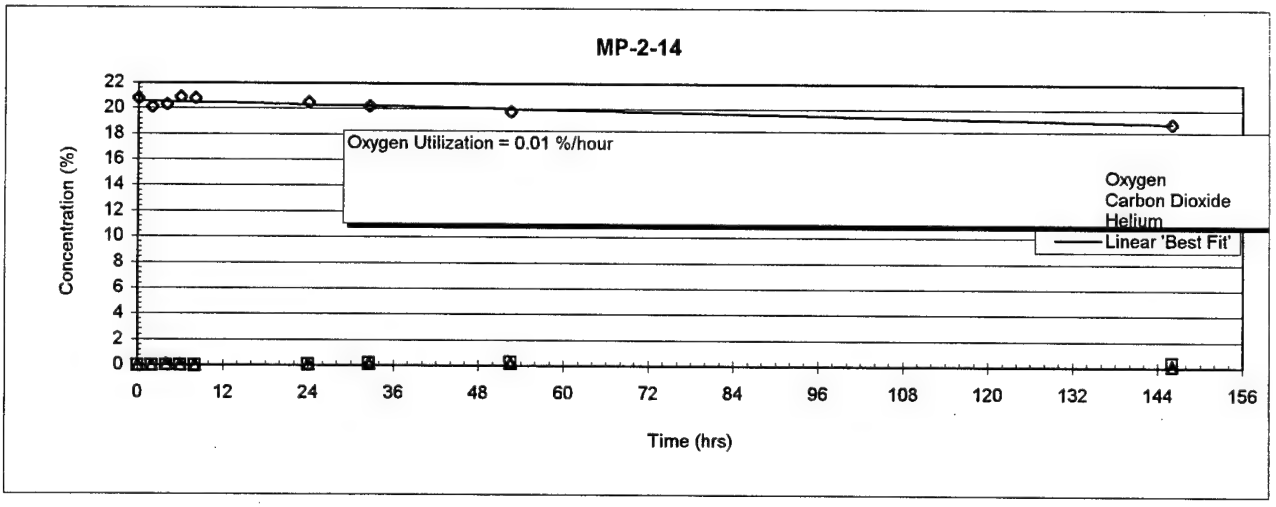
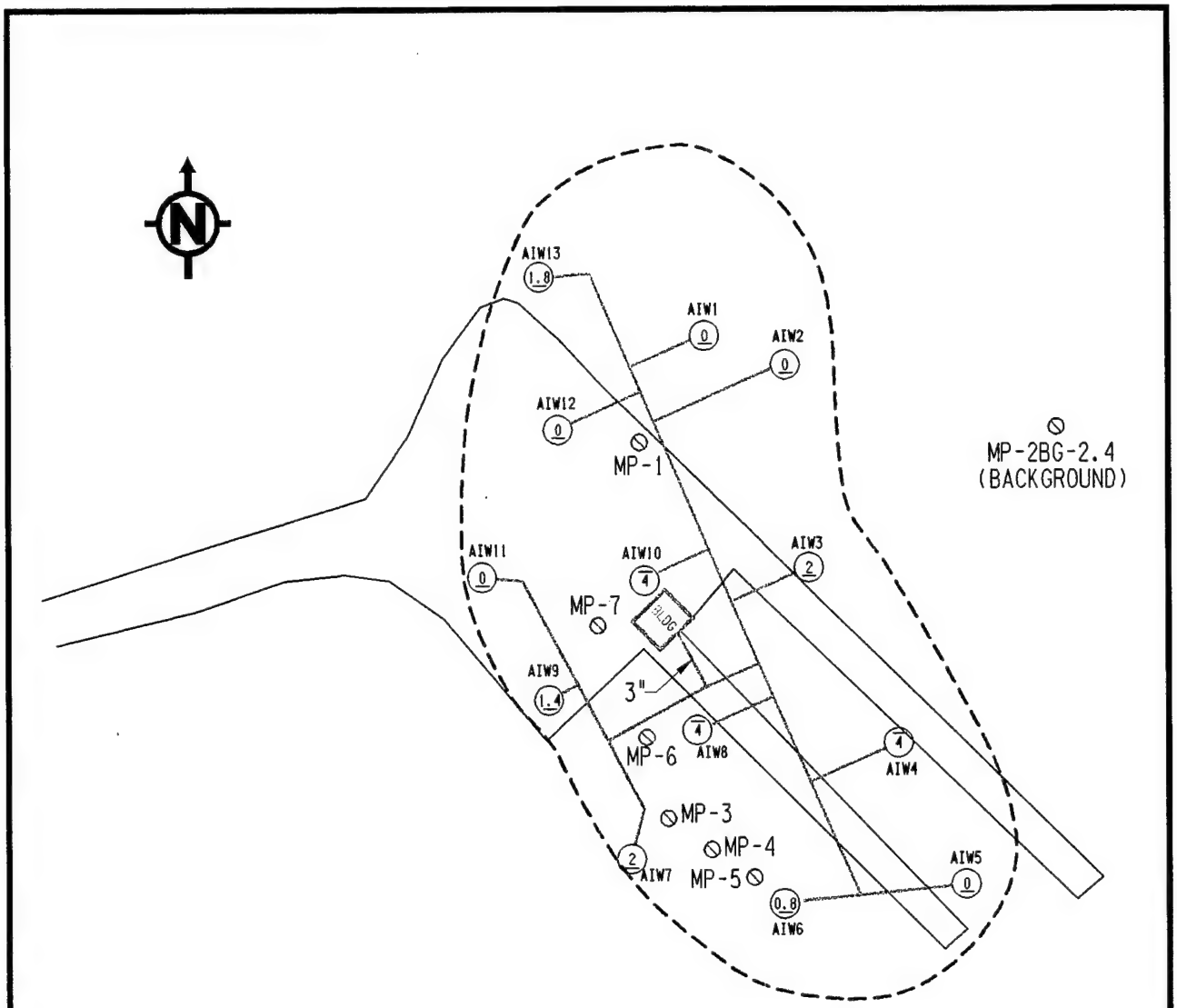


Figure 3 - 9 Fall 1996 Respiration Test Results for MP-2-3 and MP-2-14 at the Entomology Shop



LEGEND

- EXTENT OF CONTAMINATION (URS 1995)
- (1.4) AIR INJECTION WELL (Dec 1996 air flow measurement)
  - underline = below design flow
  - overline = above design flow
  - no line = at design flow
- MONITORING POINT (W/O O_2 SENSOR)
- BLDG SUPPORT BLDG AND HOSE CONNECTIONS

MONITORING POINT	SEP-96		OCT-96	NOV-96	DEC-96
	O_2(%)	O_2UTIL RATE %/HR	O_2(%)	O_2(%)	O_2(%)
MP-1-4	WATER		WATER	WATER	20.4
MP-2BG-2.4	WATER		WATER	WATER	FRZN
MP-3-6	WATER		WATER	WATER	20.5
MP-4-6	WATER		WATER	WATER	20.5
MP-5-6	WATER		WATER	WATER	20.5
MP-6-3	17.7		20.5	WATER	FRZN
MP-7-3	9.8	**0.66**	17.8	WATER	FRZN

NOTES:
1. DESIGN FLOW PER WELL = 3 SCFM.

2. MONITORING POINT DEPTH IS FROM GROUND SURFACE TO TOP OF SCREEN.

ABBREVIATIONS:
FRZN FROZEN

0 50 100
SCALE IN FEET

22784/043/FIG2-9.DGN

Figure 3-10
FJETC Biovent System Layout and Well Head Flow (Dec 1996 Air Flow)

Table 3 - 6 FJETC Air Flow and Monitoring Point Data

Air injection Well	Screen Interval ft/bgs top	bottom	Overburden Pressure[1] (psi)	Design Air Flow (scfm)	Individual Well Head Flow (scfm) September 1996 [2]	October 1996	November 1996	December 1996	January 1997
AIW-1	7.8	12.8	5.4	3	0.0	1.0	0.0	0.0	0.0
AIW-2	7.9	12.8	5.5	3	0.0	0.0	0.0	0.0	0.0
AIW-3	6.9	11.8	4.8	3	0.0	5.5	nr	2.0	3.0
AIW-4	2	6	1.4	3	3.0	4.0	4.0	4.0	3.0
AIW-5	6.9	11.8	4.8	3	0.0	0.0	0.0	0.0	0.0
AIW-6	6.8	11.8	4.7	3	0.0	1.0	0.0	0.8	0.0
AIW-7	7.9	12.8	5.5	3	0.0	2.0	0.0	2.0	0.0
AIW-8	2	7	1.4	3	3.0	4.0	nr	4.0	3.0
AIW-9	8.9	13.8	6.2	3	0.0	2.0	0.0	1.4	0.0
AIW-10	2	8.5	1.4	3	3.0	5.0	4.0	4.0	3.0
AIW-11	7.8	12.8	5.4	3	0.0	0.0	0.0	0.0	0.0
AIW-12	8.9	13.8	6.2	3	0.0	0.0	0.0	0.0	0.0
AIW-13	7.8	12.8	5.4	3	0.0	1.2	1.0	1.8	1.4
Total air flow:			-	39	9.0	25.7	- 9.0	20.0	13.4
Blower Information									
Date:					9/17/96	10/2/96	11/14/96	12/13/96	1/9/97
Time:					1115	1444	1250	0830	1000
Exit Temperature (°F):					68	66	64	66	62
Pressure (psi):					1.8	3.1	4.25	3.7	3.9

Monitoring Point	Screen Interval (ft bgs) top	bottom		Soil Gas Sampling Results September 1996 [3] O (%)	CO2 (%)	TVH (ppmv)	October 1996 O (%)	CO (%)	TVH (ppmv)	November 1996 O (%)	CO2 (%)	TVH (ppmv)	December 1996 O (%)	CO2 (%)	TVH (ppmv)	January 1997 O (%)	CO (%)	TVH (ppmv)
MP-1-4	4	4.5		Water in line			Water in line			Water in line			20.4	0.0	6		Frozen	
MP-2BG-2.4	2.4	8	Background location	Water in line			Water in line			Water in line				Frozen			Frozen	
MP-3-6	6	6.5		Water in line			Water in line			Water in line			20.5	0.0	29		Frozen	
MP-4-6	6	6.5		Water in line			Water in line			Water in line			20.5	0.0	12		Frozen	
MP-5-6	6	6.5		Water in line			Water in line			Water in line			20.5	0.0	16		Frozen	
MP-6-3	3	3.5		17.7	1.9	23	20.5	0.0	93	Water in line				Frozen			Frozen	
MP-7-3	3	3.5	O_2 Util. Rate = 0.66%/hr[4]	9.8	8.1	4000	17.8	1.5	4500	Water in line				Frozen			Frozen	

[1] Maximum pressure before potential for fracturing of soil. Calculated at top of screen assuming density of soil is 100 lbs/ft^3.
[2] System on for only two hours for testing. System shut down June - Sept due to high water table.
[3] System off for respiration testing.
[4] Test performed on 9/28/96.
nr = no reading, bgs = below ground surface

Time[1] (hrs)	MP-7-3			
	O_2	CO_2	TVH	Helium
0	20.3	0	40	1
2	19	0	185	1
4	17.4	0.2	210	1
6	16.6	0.2	230	0.77
8	14.4	0.4	250	0.92
13	10	0.9	500	0.53
24	4.8	2	217	0.43

[1] Test began on 9/28/96 at 08:15

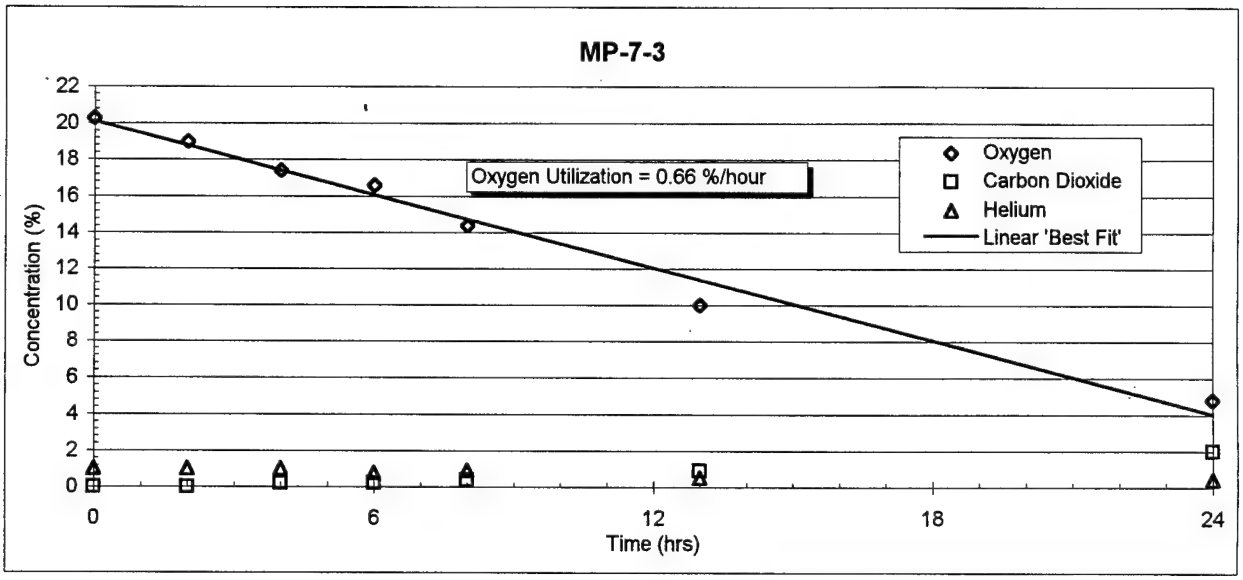


Figure 3-11 Fall 1996 Respiration Test Results for MP-7-3 at the Former Jet Engine Test Cell

be reaching this zone from AIW 10, although this would only be in the upper 8 ft of soil. AIWs 1, 2, 11, and 12 are all screened from 8 to 13 ft bgs.

The high oxygen level at MP-6-3 in September 1996, while the system was off, was attributed to being screened in uncontaminated soil. During the same month, MP-7-3 also had relatively high oxygen levels (above 5 percent), but also high volatiles. These features, along with the elevated carbon dioxide levels, indicate that biodegradation was occurring. Since air was not being injected at the time of sampling, oxygen is suspected of being provided naturally through diffusion. These MPs were unusable from November 1996 through January 1997.

Three MPs (AIWs 3, 4, and 5) that had high water levels interfere with all attempts to sample through November 1996, are now indicating high oxygen levels. These oxygen levels are high most likely due to one or more of the following conditions: (1) the surrounding AIWs are providing an abundance of air, (2) oxygen is available through natural diffusion, and (3) oxygen utilization decreased in the winter.

Overall Recommendation for FJETC: Soil samples to the north and in the vicinity of AIWs 1, 2, 11, and 12 are needed to define contamination in this area. These AIWs have been unable to accept airflow since system startup. If contamination exists in this area and soil sampling suggests that permeable soils exist, replacement AIWs and additional MPs are recommended for this area. If soil sampling confirms the presence of less permeable soils and/or perched water, excavation of the contaminated soils will be evaluated.

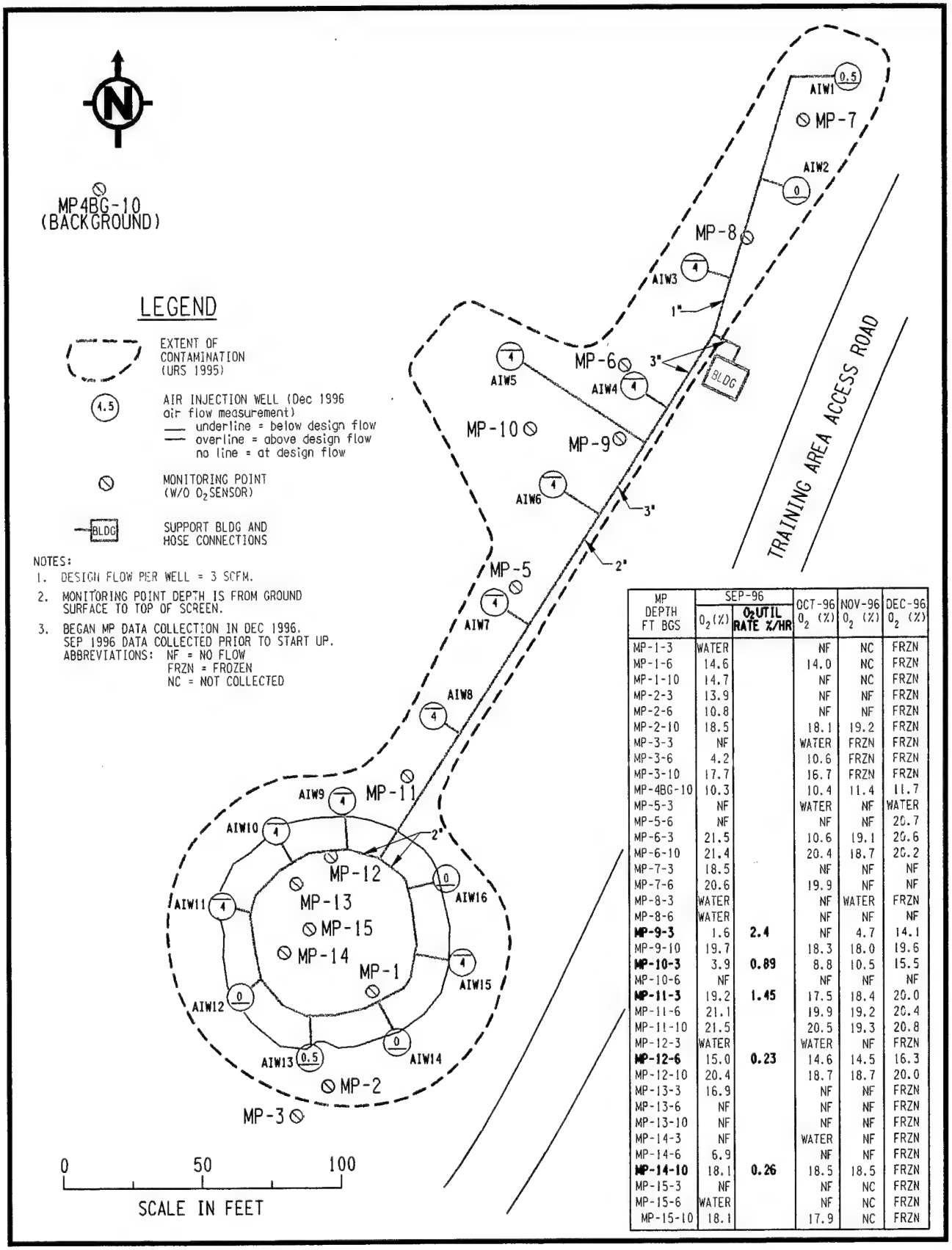
If MPs 1 through 5 remain unusable during the first half of the summer months, it is recommended that several new MP locations be selected and the monitoring interval be investigated for water content/level prior to installation. If oxygen levels remain high in the MP-6 and MP-7 area, air flow into AIWs 8 and 10 will be reduced. During times when water levels are predominantly high throughout the site, injection rates will be reduced.

Oxygen sensors should be installed in areas where saturated conditions frequently exist. Intermittent drops in water levels will result in the sporadic collection of oxygen levels.

3.7 FIRE TRAINING AREA

3.7.1 Operations

The FTA, located in OU 8, consists of 16 AIWs and 37 MPs (Figure 3-12). The FTA biovent system was installed by BEI in the fall of 1995. Since BEI has assumed responsibility for the bioventing O&M, the system has operated 328 days. This system was down during portions of the summer due to high water levels, but has operated continuously since early July, with minor interruptions for respiration testing and general maintenance. Several power outages have also occurred at this site, the most notable caused by a bear climbing the power pole and blowing the fuse to the transformer.



MP DEPTH FT BGS	SEP-96 O_2 (%)	SEP-96 O_2 UTIL RATE %/HR	OCT-96 O_2 (%)	NOV-96 O_2 (%)	DEC-96 O_2 (%)
MP-1-3	WATER		NF	NC	FRZN
MP-1-6	14.6		14.0	NC	FRZN
MP-1-10	14.7		NF	NC	FRZN
MP-2-3	13.9		NF	NF	FRZN
MP-2-6	10.8		NF	NF	FRZN
MP-2-10	18.5		18.1	19.2	FRZN
MP-3-3	NF		WATER	FRZN	FRZN
MP-3-6	4.2		10.6	FRZN	FRZN
MP-3-10	17.7		16.7	FRZN	FRZN
MP-4BG-10	10.3		10.4	11.4	11.7
MP-5-3	NF		WATER	NF	WATER
MP-5-6	NF		NF	NF	20.7
MP-6-3	21.5		10.6	19.1	20.6
MP-6-10	21.4		20.4	18.7	20.2
MP-7-3	18.5		NF	NF	NF
MP-7-6	20.6		19.9	NF	NF
MP-8-3	WATER		NF	WATER	FRZN
MP-8-6	WATER		NF	NF	NF
MP-9-3	1.6	**2.4**	NF	4.7	14.1
MP-9-10	19.7		18.3	18.0	19.6
MP-10-3	3.9	**0.89**	8.8	10.5	15.5
MP-10-6	NF		NF	NF	NF
MP-11-3	19.2	**1.45**	17.5	18.4	20.0
MP-11-6	21.1		19.9	19.2	20.4
MP-11-10	21.5		20.5	19.3	20.8
MP-12-3	WATER		WATER	NF	FRZN
MP-12-6	15.0	**0.23**	14.6	14.5	16.3
MP-12-10	20.4		18.7	18.7	20.0
MP-13-3	16.9		NF	NF	FRZN
MP-13-6	NF		NF	NF	FRZN
MP-13-10	NF		NF	NF	FRZN
MP-14-3	NF		WATER	NF	FRZN
MP-14-6	6.9		NF	NF	FRZN
MP-14-10	18.1	**0.26**	18.5	18.5	FRZN
MP-15-3	NF		NF	NC	FRZN
MP-15-6	WATER		NF	NC	FRZN
MP-15-10	18.1		17.9	NC	FRZN

22784/043/FIG2-11.DGN

Figure 3-12
FTA Biovent System Layout and Well Head Flow (Dec 1996 Air Flow)

Injection flows have remained consistent at the FTA at average near 2.5 cfm per well (design is 3.0 cfm); however, the injection pressure has been increased from 1.7 psi to 3.5 psi (Table 3-7). In general, the majority of the site is covered with AIWs that accept air, although AIWs 2, 12, 14, and 16 have not allowed air to be injected since system startup. Nearby AIWs 9, 10, and 15 flow rates have been adjusted above the design rate in an effort to supply air to the area around the AIWs not accepting air. This site has the greatest number of MPs that yield soil gas samples, primarily due to the number of MPs available. Seventeen of the 37 MPs provided soil gas data during the month of October, a ratio typical for most of the sites.

3.7.2 Conclusions and Recommendations

Soil gas samples collected from MP-9 and MP-10, both located near AIWs 4, 5 and 6, had oxygen levels below 5 percent. Flows at these AIWs were subsequently raised and the oxygen levels increased to above 5 percent in October. In November, the MP-9-3 oxygen level dipped to 4.7 percent but in December rebounded to 14.1 percent. The fluctuations in oxygen levels may be attributed to varying air pathways (changes in soil moisture) and changing oxygen utilization rates (function of ambient temperatures).

Of the five respiration tests run in the fall, the average oxygen utilization rate was 1.0 percent/hr which consisted of a range from 0.23 to 2.4 percent/hr (Figures 3-13 and 3-14). Two points, MP-12-6 and MP-14-8.5, had respiration tests performed in both the summer and fall, with the average rate being 0.24 percent/hr for both tests.

Overall Recommendation for FTA: Suspected contaminated areas are consistently being aerated via fully functional AIWs. No changes or additions to the system are suggested at this time.

3.8 FUEL TANK FARM

3.8.1 Operations

The FTF bioslurp and biovent system, which was installed by COE, is located in OU 11. The system is made up of 17 bioslurp wells, 21 biovent wells, and 8 monitoring point locations (15 monitoring points). The FTF began operation in November 1996 in bioslurp (extraction) mode for approximately 3 days. It then changed to operate in biovent (injection) mode to prevent aboveground lines from freezing. The FTF system has operated in bioventing mode for a total of 77 days through January 1997. Biovent mode consists of 20 AIWs [bioslurp point (BS) and BV wells] and 15 MPs (Figure 3-15). In January 1997, 15 out of the 20 AIWs were accepting flow (Table 3-8). Four of the 15 MPs are oxygen sensors. Oxygen sensor data was collected from MP-8 in December and January.

The FTF bioventing/bioslurping system is anticipated to be operated in bioslurp mode beginning in April or May, when freezing of above ground lines no longer becomes a concern. An additional bioventing system is also scheduled to be installed at the FTF in 1997. Preliminary plans show the biovent system consisting of 40 AIWs.

Table 3 - 7 FTA Air Flow and Monitoring Point Data

Air Injection Well	Screen Interval ft/bgs top	bottom	Overburden Pressure[1] (psi)	Design Air Flow (scfm)	Individual Well Head Flow (scfm) September 1996	October 1996	November 1996	December 1996	January 1997
AIW-1	6.9	11.8	4.8	3	0.0	0.0	0.0	0.5	1.6
AIW-2	6.4	11.3	4.4	3	0.0	0.0	0.0	0.0	0.0
AIW-3	6.9	11.8	4.8	3	3.5	3.6	4.0	4.0	3.5
AIW-4	6.1	11.1	4.2	3	2.8	3.0	3.0	4.0	4.0
AIW-5	7.4	12.3	5.1	3	4.2	5.0	4.0	4.0	3.2
AIW-6	7.2	12.1	5.0	3	4.4	5.0	4.0	4.0	4.0
AIW-7	6.4	11.3	4.4	3	3.9	3.8	4.0	4.0	3.6
AIW-8	6.9	11.8	4.8	3	4.0	3.8	4.0	4.0	3.5
AIW-9	4.1	9	2.8	3	4.4	4.4	4.0	4.0	4.0
AIW-10	4.9	9.8	3.4	3	4.2	4.0	4.0	4.0	3.5
AIW-11	3.9	8.8	2.7	3	2.2	2.4	3.0	4.0	3.5
AIW-12	4.6	9.5	3.2	3	0.0	0.0	0.0	0.0	0.0
AIW-13	2.8	8.8	1.9	3	0.0	0.0	0.0	0.5	4.0
AIW-14	4.4	9.3	3.1	3	0.0	0.0	0.0	0.0	0.0
AIW-15	7.4	12.3	5.1	3	4.4	4.5	4.0	4.0	4.0
AIW-16	4.9	9.8	3.4	3	0.0	0.0	0.0	0.0	0.0
Total air flow:				48	38.0	39.5	38.0	41.0	42.4
Blower Information									
Date:					9/10/96	10/11/96	11/14/96	12/12/96	1/10/97
Time:					1500	1506	1400	0915	0815
Exit Temperature (°F):					78	67	60	59	60
Pressure (psi):					1.7	1.8	2	3.8	3.5

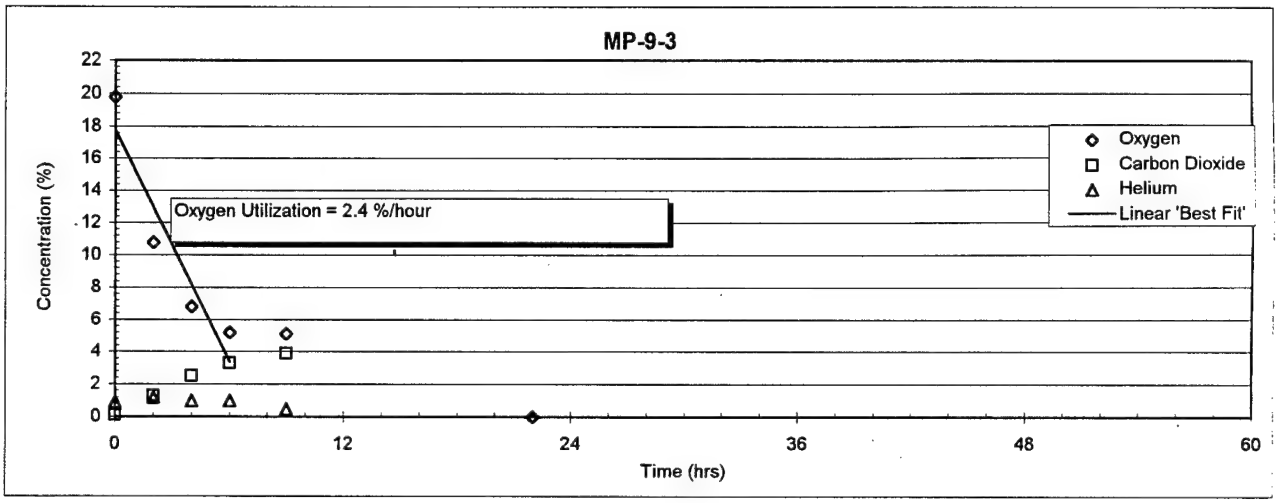
Monitoring Point	Screen Interval (ft bgs) top	bottom		Soil Gas Sampling Results September 1996 O_2 (%)	CO_2 (%)	TVH (ppmv)	October 1996 O_2 (%)	CO_2 (%)	TVH (ppmv)	November 1996 O_2 (%)	CO_2 (%)	TVH (ppmv)	December 1996 O_2 (%)	CO_2 (%)	TVH (ppmv)	January 1997 O_2 (%)	CO_2 (%)	TVH (ppmv)
MP-1-3	3	3.5		Liquid in line				No flow		Ice block in road box				Frozen			Frozen	
MP-1-6	6	6.5		14.6	7.8	10000+	14.0	6.6	4500	Ice block in road box				Frozen			Frozen	
MP-1-10	10	10.5		14.7	6.8	5800		No flow		Ice block in road box				Frozen			Frozen	
MP-2-3	3	3.5		13.9	6.0	600		No flow			No flow			Frozen			Frozen	
MP-2-6	6	6.5		10.8	7.0	2100		No flow			No flow			Frozen			Frozen	
MP-2-10	10	10.5		18.5	1.8	2420	18.1	2.2	988	19.2	0.1	270		Frozen			Frozen	
MP-3-3	3	3.5			No flow			Water in line			No flow - frozen			Frozen			Frozen	
MP-3-6	6	6.5		4.2	6.5	60	10.6	9.2	0		No flow - frozen			Frozen			Frozen	
MP-3-10	10	10.5		17.7	1.8	1260	16.7	3.6	540		No flow - frozen			Frozen			Frozen	
MP-4BG-4.4	4.4	10	Background location	10.3	3.0	43	10.4	2.6	0	11.4	1.9	1	11.7	1.8	5		Frozen	
MP-5-3	3	3.5			No flow			Water in line			No flow			Water in line			Frozen	
MP-5-6	6	6.5			No flow			No flow			No flow		20.7	0	116		Frozen	
MP-6-3	3	3.5		21.5		70	20.6	0.0	29	19.1	0.0	1.5	20.6	0.0	7		Frozen	
MP-6-10	10	10.5		21.4	0.5	35	20.4	0.5	10	18.7	0.5	1.5	20.2	0.3	5		Frozen	
MP-7-3	3	3.5		18.5	2.7	16		No flow			No flow			No flow			Frozen	
MP-7-6	6	6.5		20.6	1.7	30	19.9	1.4	14		No flow			No flow			Frozen	
MP-8-3	3	3.5			Water in line			No flow			Water in line			Frozen			Frozen	
MP-8-6	6	6.5			Water in line			No flow			No flow			No flow			Frozen	
MP-9-3	3	3.5	O_2 Util. Rate = 2.4%/hr[2]	1.6	17.5	1200		No flow		4.7	10.3	0	14.1	2.5	496		Frozen	
MP-9-10	10	10.5		19.7	1.9	1600	18.3	3.2	1425	18.0	2.4	550	19.6	0.9	2150		Frozen	
MP-10-3	3	3.5	O_2 Util. Rate = 0.89%/hr[2]	3.9	15.0	300	8.8	10.0	0	10.5	6.1	0	15.5	2.4	1320		Frozen	
MP-10-6	6	6.5			No flow			No flow			No flow			No flow			Frozen	
MP-11-3	3	3.5	O_2 Util. Rate = 1.45%/hr[2]	19.2	1.5	300	17.5	2.3	64	18.4	1.2	62	20.0	0.5	34		Frozen	
MP-11-6	6	6.5		21.1	0.3	67	19.9	0.2	13	19.2	0.2	0	20.4	0.2	26		Frozen	
MP-11-10	10	10.5		21.5		40	20.5	0.0	21	19.3	0.1	1	20.8	0.0	22		Frozen	
MP-12-3	3	3.5			Water in line			Water in line			No flow			Frozen			Frozen	
MP-12-6	6	6.5	O_2 Util. Rate = 0.23%/hr[2]	15.0	6.1	65	14.6	6.0	23	14.5	2.9	6	16.3	1.4	8 (w/ PID)		Frozen	
MP-12-10	8.5	9		20.4	1.0	76	18.7	1.4	30	18.7	0.9	18	20.0	0.6	18		Frozen	
MP-13-3	3	3.5		16.9	4.0	800		No flow			No flow			Frozen			Frozen	
MP-13-6	6	6.5			No flow			No flow			No flow			Frozen			Frozen	
MP-13-10	7	7.5			No flow			No flow			No flow			Frozen			Frozen	
MP-14-3	3	3.5			No flow			Water in line			No flow			Frozen			Frozen	
MP-14-6	6	6.5		6.9	8.9	2200		No flow			No flow			Frozen			Frozen	
MP-14-8.5	8.5	9	O_2 Util. Rate = 0.26%/hr[2]	18.1	2.5	1040	18.5	1.4	380	18.5	1.1	142		Frozen			Frozen	
MP-15-3	3	3.5			No flow			No flow		Ice block in road box				Frozen			Frozen	
MP-15-6	6	6.5			Water in line			No flow		Ice block in road box				Frozen			Frozen	
MP-15-10	9	9.5		18.1	3.3	2800	17.9	2.9	675	Ice block in road box				Frozen			Frozen	

[1] Maximum pressure before potential for fracturing of soil. Calculated at top of screen assuming density of soil is 100 lbs/ft^3.
[2] Test performed on 9/23/96.

N_FTA XLS
6/4/97

Time[1] (hrs)	MP-9-3				MP-10-3			
	O_2	CO_2	TVH	Helium	O_2	CO_2	TVH	Helium
0.0	19.8	0.1	79	0.91	20.2	0.2	52	1
2.0	10.8	1.3	150	1.2	16.9	1.2	230	0.92
4.0	6.8	2.5	100	0.97	14.1	2.1	245	0.81
6.0	5.2	3.3	23	0.97	13.2	2.5	200	0.85
9.0	5.1	3.9	63	0.48	12	3.1	186	0.63
22.0		End of test			9	5	229	0.42
27.0					8	5.6	176	0.31
31.0					7.9	5.8	217	0.3
45.5					6.8	6.6	205	0.15
53.5					7.2	6.6	212	0.12

[1] Test began on 9/23/96 at 08:00



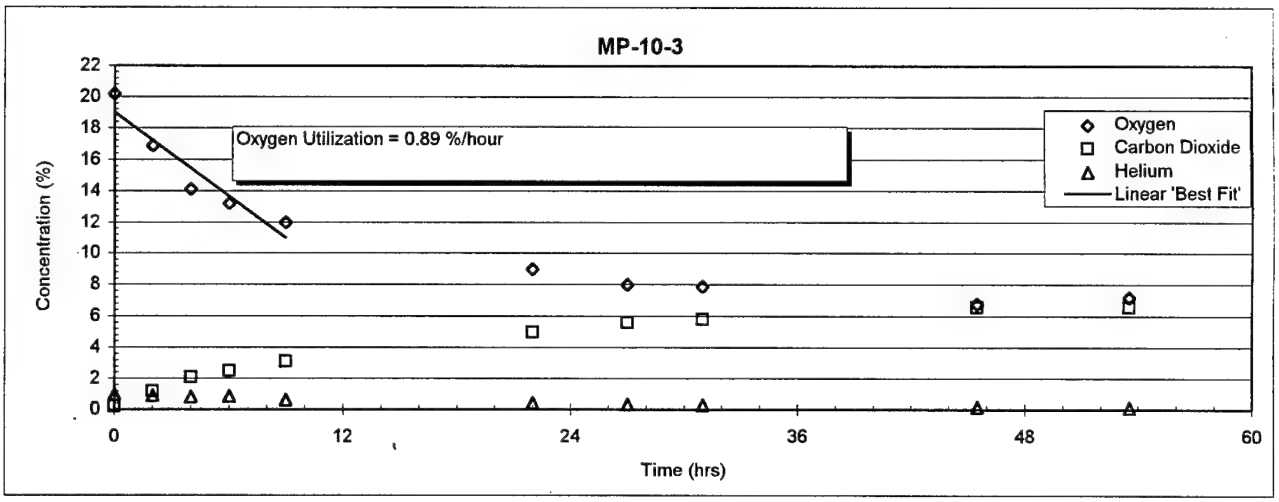
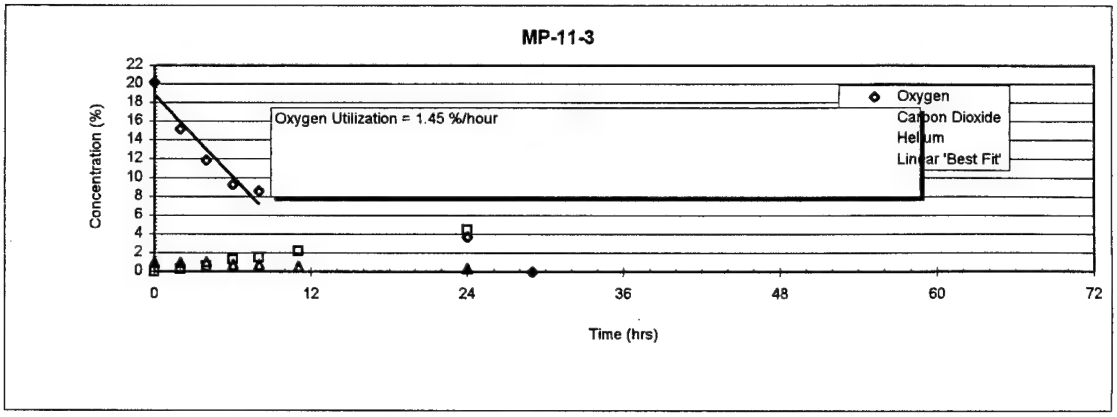
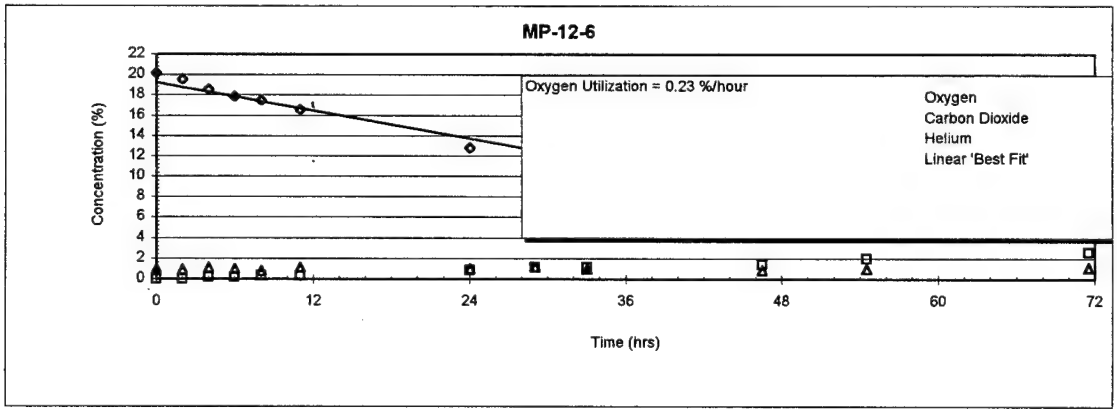


Figure 3 - 13 Fall 1996 Respiration Test Results for MP-9-3 and MP-10-3 at the Fire Training Area

Time[1] (hrs)	MP-11-3				MP-12-6				MP-14-8.5			
	O_2	CO_2	TVH	Helium	O_2	CO_2	TVH	Helium	O_2	CO_2	TVH	Helium
0.0	20.2	0	21	0.93	20.2	0	18	0.97	20.3	0	18	1.1
2.0	15.2	0.3	130	0.99	19.6	0	15	0.93	20.3	0	40	0.74
4.0	11.9	0.6	140	1	18.6	0.2	18	1.1	19.8	0	35	0.8
6.0	9.3	1.3	154	0.73	17.9	0.2	17	1	19.1	0	58	0.74
8.0	8.6	1.5	123	0.78	17.5	0.3	18	0.82	18.4	0	45	0.91
11.0	8.1	2.2	106	0.53	16.6	0.3	15	1.1	17.8	0	52	1.1
24.0	3.7	4.5	68	0.31	12.8	0.9	22	0.98	14.7	0	77	1
29.0		End of test			11	1.2	17	1.2	11.3	0.1	53	0.79
33.0					10.7	1.2	9	1	10	0.1	43	0.85
46.5					7.7	1.4	13	0.86	6.5	0.1	48	0.96
54.5					6.6	2	10	1	6.1	0.2	47	0.86
71.5					4.1	2.6		1.1	3.2	0.2		0.83

[1] Test began on 9/23/96 at 08:00





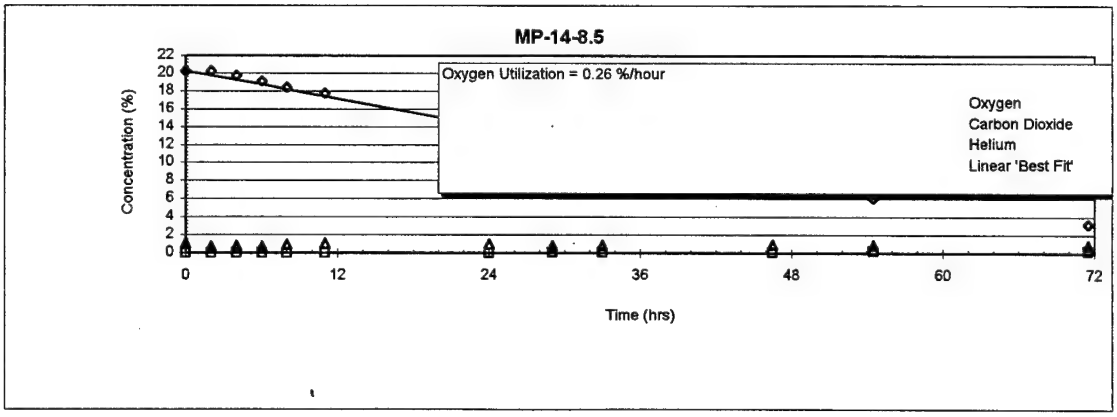
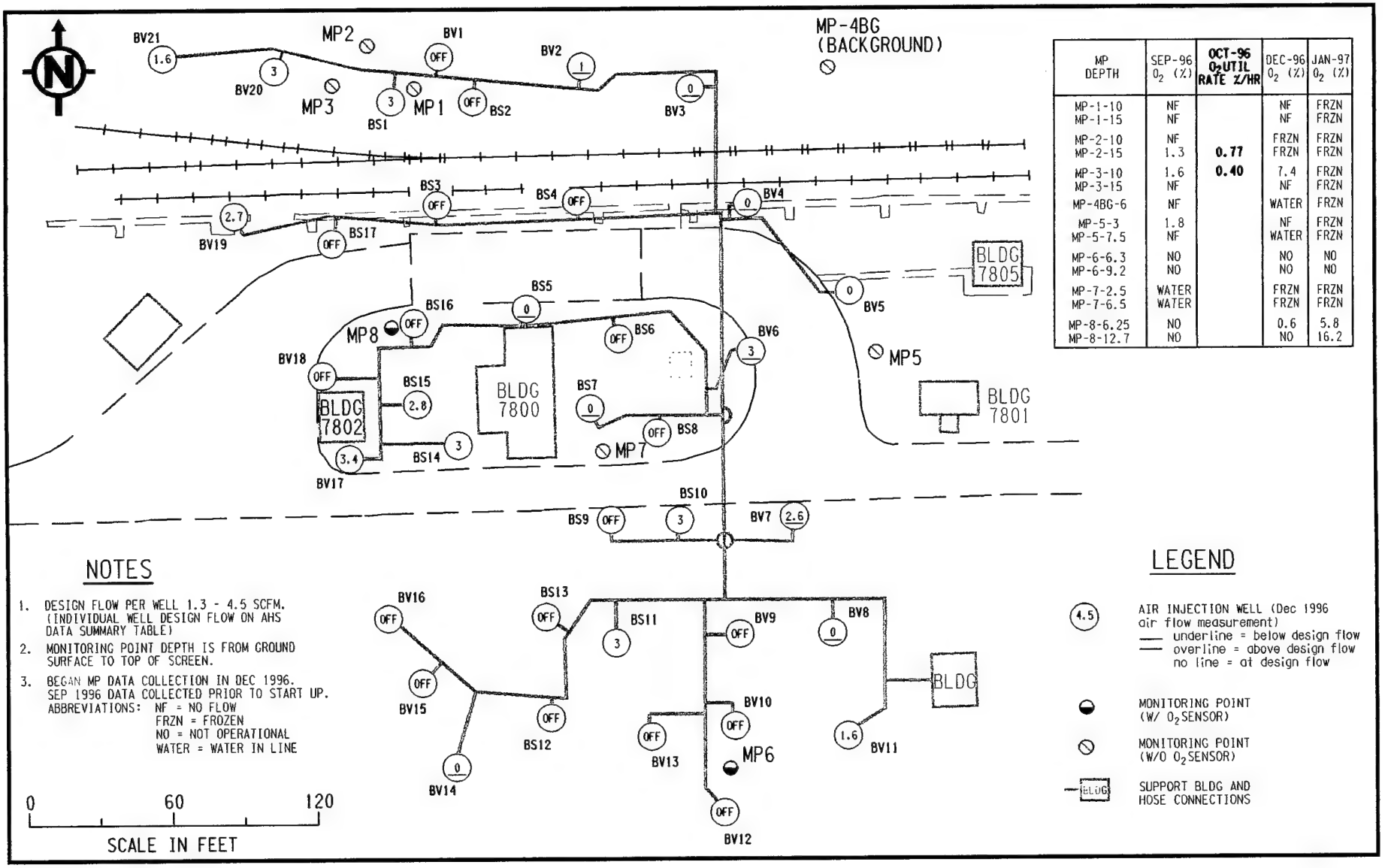


Figure 3 - 14 Fall 1996 Respiration Test Results for MP-11-3, MP-12-6, and MP-14-8.5 at the Fire Training Area



MP DEPTH	SEP-96 O_2 (%)	OCT-96 O_2 UTIL RATE %/HR	DEC-96 O_2 (%)	JAN-97 O_2 (%)
MP-1-10	NF		NF	FRZN
MP-1-15	NF		NF	FRZN
MP-2-10	NF		FRZN	FRZN
MP-2-15	1.3	**0.77**	FRZN	FRZN
MP-3-10	1.6	**0.40**	7.4	FRZN
MP-3-15	NF		NF	FRZN
MP-4BG-6	NF		WATER	FRZN
MP-5-3	1.8		NF	FRZN
MP-5-7.5	NF		WATER	FRZN
MP-6-6.3	NO		NO	NO
MP-6-9.2	NO		NO	NO
MP-7-2.5	WATER		FRZN	FRZN
MP-7-6.5	WATER		FRZN	FRZN
MP-8-6.25	NO		0.6	5.8
MP-8-12.7	NO		NO	16.2

22784/043/FIG2-13.DGN

Figure 3-15
FTF Biovent System Layout and Well Head Flow (Dec 1996 Air Flow)

Table 3 - 8 FTF Air Flow and Monitoring Point Data

Air Injection Well [1]	Screen Interval ft/bgs top	bottom	Overburden Pressure[2] (psi)	Design Air Flow (scfm)	Individual Well Head Flow (scfm) [3] September 1996	October 1996	November 1996	December 1996	January 1997
BV-2	12	19	8.3	3				1.0	1.3
BV-3	12	17	8.3	3				0.0	0.0
BV-4	11	18	7.6	2.7				0.0	0.0
BV-5	11	18	7.6	2.7				0.0	1.8
BV-6	4	12	2.8	3.7				3.0	3.7
BV-7	5	15	3.5	3.4				2.6	3.4
BV-8	5	15	3.5	2.2				0.0	1.0
BV-11	6	13	4.2	1.6				1.6	1.8
BV-14	6	13	4.2	1.6				0.0	0.0
BV-17	5	15	3.5	3.4				3.4	3.4
BV-19	10	18	6.9	2.7				2.7	2.7
BV-20	12	19	8.3	3				3.0	3.0
BV-21	14	19	9.7	1.6				1.6	1.6
BS-1	12	19	8.3	3				3.0	3.0
BS-5	10	17	6.9	3				0.0	0.0
BS-7	8	15	5.6	3				0.0	0.0
BS-10	5	15	3.5	3				3.0	3.0
BS-11	4.5	14.5	3.1	3				3.0	3.0
BS-14	8	15	5.6	3				3.0	3.0
BS-15	10	17	6.9	3				2.8	1.8
				55.6				33.7	37.5
Blower Information									
Date:								12/11/96	1/9/97
Time:								1330	1134
Exit Temperature (°F):								80	78
Pressure (psi):								3.2	3

Monitoring Point	Screen Interval (ft bgs) top	bottom		Soil Gas Sampling Results [3] September 1996 O_2 (%)	CO_2 (%)	TVH (ppmv)	October 1996 O_2 (%)	CO_2 (%)	TVH (ppmv)	November 1996 O_2 (%)	CO_2 (%)	TVH (ppmv)	December 1996 O_2 (%)	CO_2 (%)	TVH (ppmv)	January 1997 O_2 (%)	CO_2 (%)	TVH (ppmv)
MP-1-10	10	10.5			No flow									No flow			Frozen	
MP-1-15	15	15.5			No flow									No flow			Frozen	
MP-2-10	10	10.5			No flow									Frozen			Frozen	
MP-2-15	15	15.5	O_2 Util. Rate = 0.77%/hr[4]	1.3	16.1	>10000								Frozen			Frozen	
MP-3-10	10	10.5	O_2 Util. Rate = 0.4%/hr[4]	1.6	12.2	>10000							7.4	7.1	nr		Frozen	
MP-3-15	15	15.5			No flow									No flow			Frozen	
MP-4BG-6	6	11	Background location		No flow									Water in line			Frozen	
MP-5-3	3	3.5		1.8	8.4	>10000								No flow			Frozen	
MP 5-7.5	7.5	8			No flow									Water in line			Frozen	
MP-6-6.3	6.3	6.8	O_2 Sensor - On 12/10/96											malfunction			malfunction	
MP-6-9.2	9.2	9.7	O_2 Sensor - On 12/10/96											malfunction			malfunction	
MP-7-2.5	2.5	3			Water in line									Frozen			Frozen	
MP-7-6.5	6.5	7			Water in line									Frozen			Frozen	
MP-8-6.25	6.25	6.75	O_2 Sensor - On 12/10/96										0.6	na	na	5.8	na	na
MP-8-12.7	12.7	13.2	O_2 Sensor - On 12/10/96											malfunction		16.2	na	na

[1] All wells are in a bioventing mode (BV = biovent & BS = bioslurp).
[2] Maximum pressure before potential for fracturing of soil. Calculated at top of screen assuming density of soil is 100 lbs/ft^3.
[3] Began data collection in December 1996.
[4] Test performed on 10/7/96.
nr = no reading, na = not applicable

3.8.2 Conclusions and Recommendations

Since flow data has been collected for only 2 months and soil gas samples were collected in December 1996 only, the long-term performance of the system has yet to be established. BVs 3, 4, and 14 and BSs 5 and 7 were the only AIWs that would not accept air during both December and January. Only MP-3-10 yielded a soil gas sample in December, and the oxygen level was 7.4 percent. The initial oxygen level at this point, prior to system start up, was 1.6 percent, showing that oxygen via injection was influencing this area. An oxygen sensor placed in MP-8-6.25 revealed oxygen levels of 0.6 and 5.8 during the months of December and January. These low levels suggest aeration in this area is insufficient.

Two pre-startup respiration tests (Figure 3-16) were run at MP-2-15 and MP-3-10. Oxygen utilization rates from these tests were 0.77 and 0.40 percent/hr, respectively. These rates are similar to rates seen at other operating sites, but lower than the pre-startup rates measured at the AHS and NDA #1. These lower rates may suggest another influence, rather than oxygen, limiting contaminant degradation (e.g., microbial population, nutrients).

Overall Recommendation for FTF: No major changes suggested. Increase airflow and pressure at BVs 3, 4, and 14 and BSs 5 and 7, but remain below 5 psi at the wellhead. These locations had zero airflow during the reporting period. MP-8-6.25 oxygen levels need to be increased therefore it is suggested that BS16 be included in the biovent mode.

3.9 NOSE DOCK AREAS #1 THROUGH #8

3.9.1 Operations

The NDA biovent systems, located in OU 5, were installed by COE during the fall of 1996. The systems had startup in October and November, also by COE, and data will be presented in the COE biovent removal action report (not published yet) for these systems. BEI began formal O&M on December 1, 1996; therefore, only data collected since this date are included in this report.

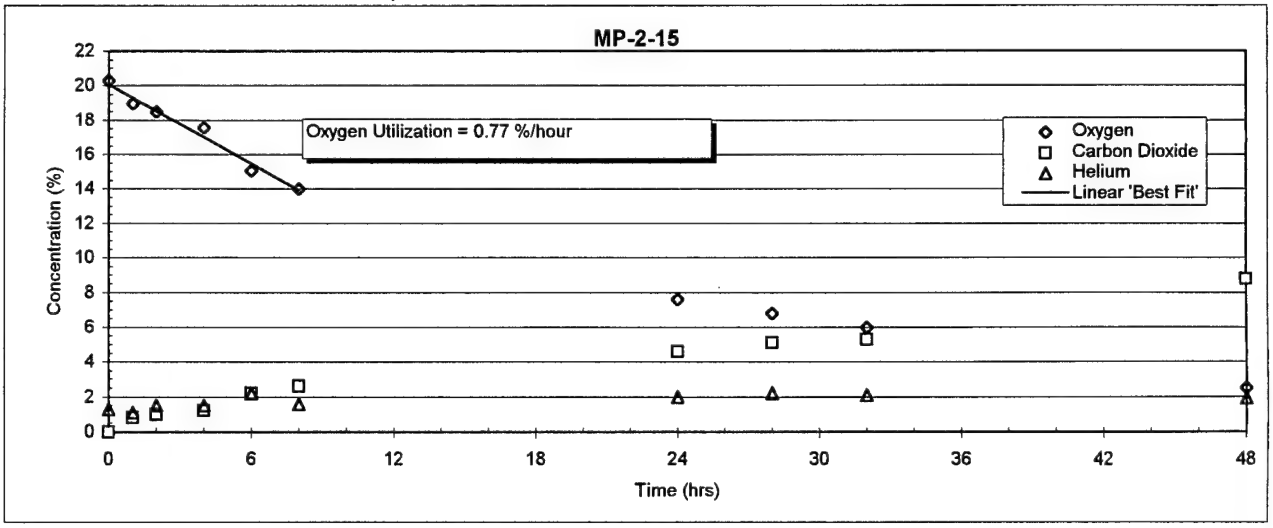
3.9.2 Conclusions and Recommendations

Since flow data has been collected for only 2 months and soil gas samples were collected in December 1996 only, the long-term performance of the system has yet to be established. As data become available from these systems, further interpretation will be made and presented in the monthly reports. A more complete summary will be presented in the next semiannual report (anticipated August 1997).

- The biovent system layouts are presented in Figure 3-17 (foldout). Wellhead flow measurements and soil gas results for the individual sites are presented in Tables 3-9 through 3-16. Two sets of soil gas measurements were made, one in September and one in December.

Time[1] (hrs)	MP-2-15				MP-3-10			
	O_2	CO_2	TVH	Helium	O_2	CO_2	TVH	Helium
0	20.3	0.0	14	1.3	20.4	0.0	21	1.0
1	19.0	0.8	213	1.1	14.5	2.7	68	1.5
2	18.5	1.0	83	1.5	13.4	3.3		1.6
4	17.6	1.2	84	1.5	12.2	3.7		1.4
6	15.1	2.2		2.2	11.0	4.0	16	1.7
8	14.0	2.6	100	1.6	10.2	4.3	19	1.6
24	7.6	4.6	185	2.0	4.8	6.6	9.5	1.4
28	6.8	5.1	145	2.2		End of test		
32	6.0	5.3	142	2.1				
48	2.5	8.8	177	1.9				

[1] Test began on 10/7/96 at 08:00



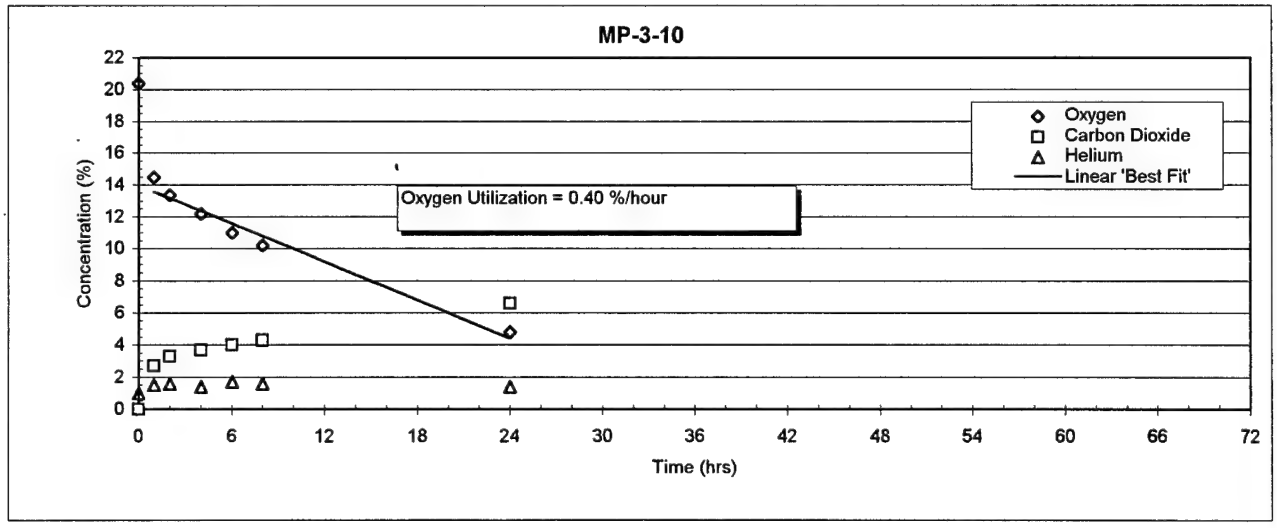
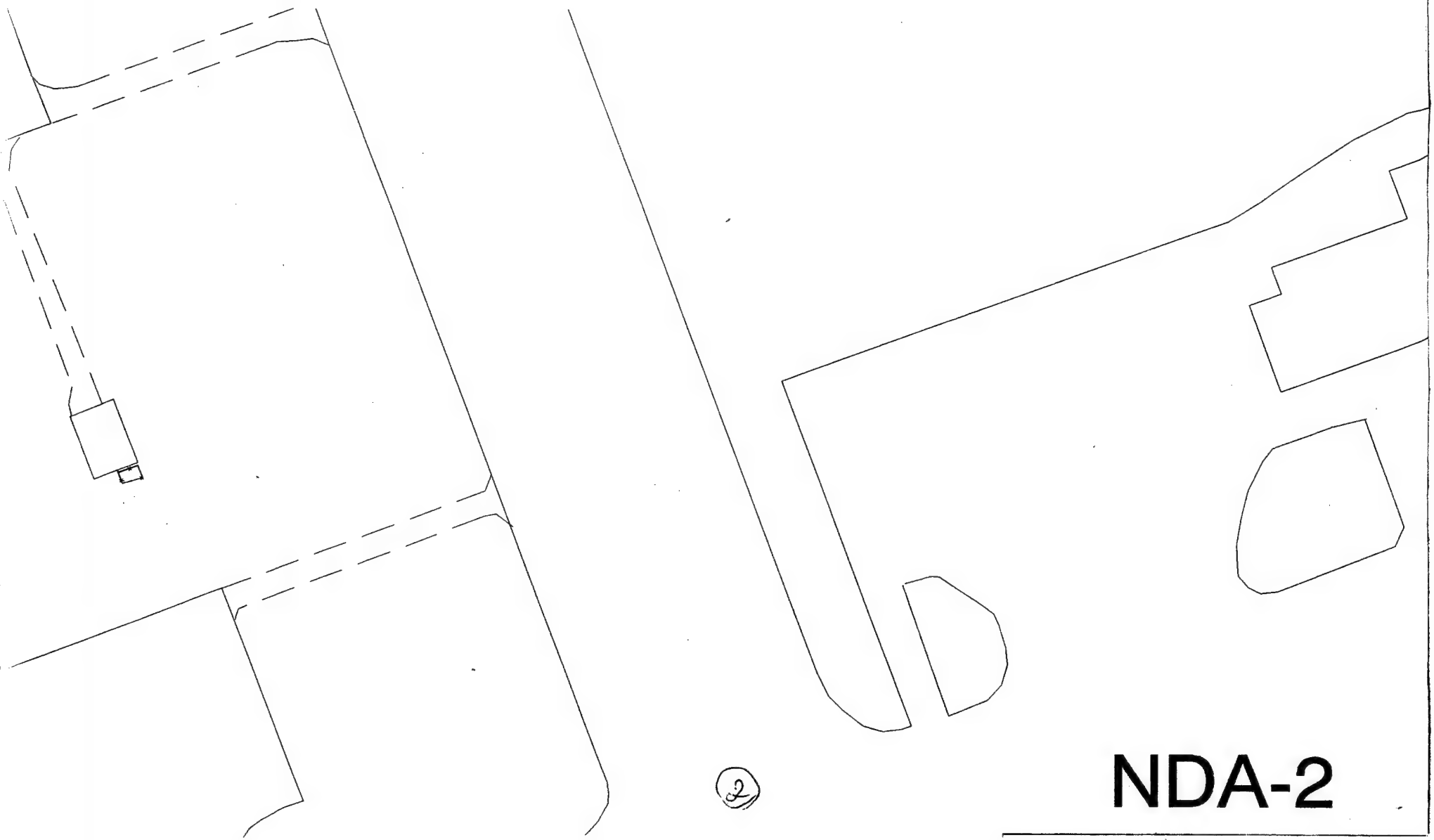


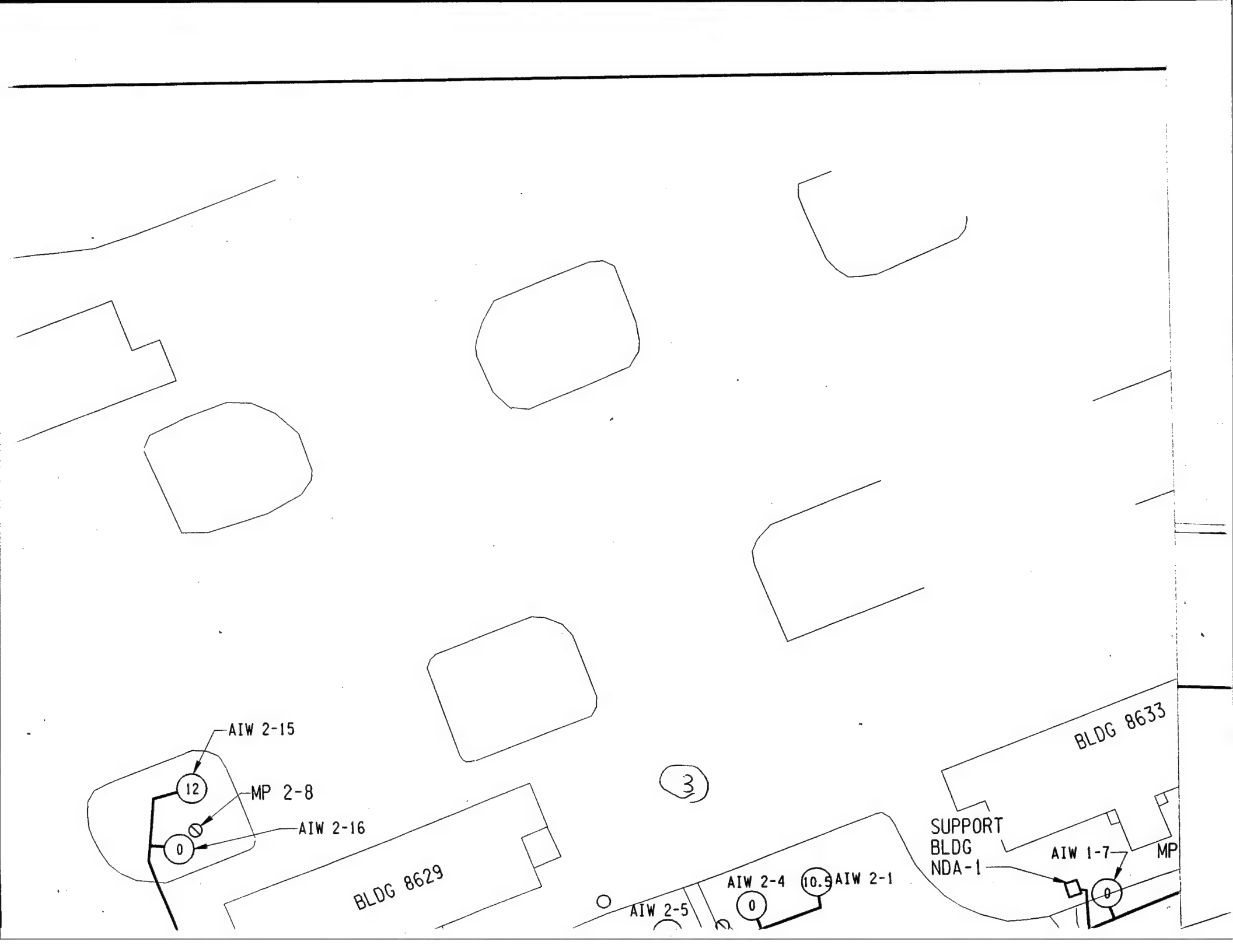
Figure 3 - 16 Pre-Startup Respiration Test Results for MP-2-15 and MP-3-10 at the Fuel Tank Farm


N



(2)

NDA-2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MP 2-8
AIW 2-16
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BLDG 8629
3
AIW 2-5
AIW 2-4
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10.5
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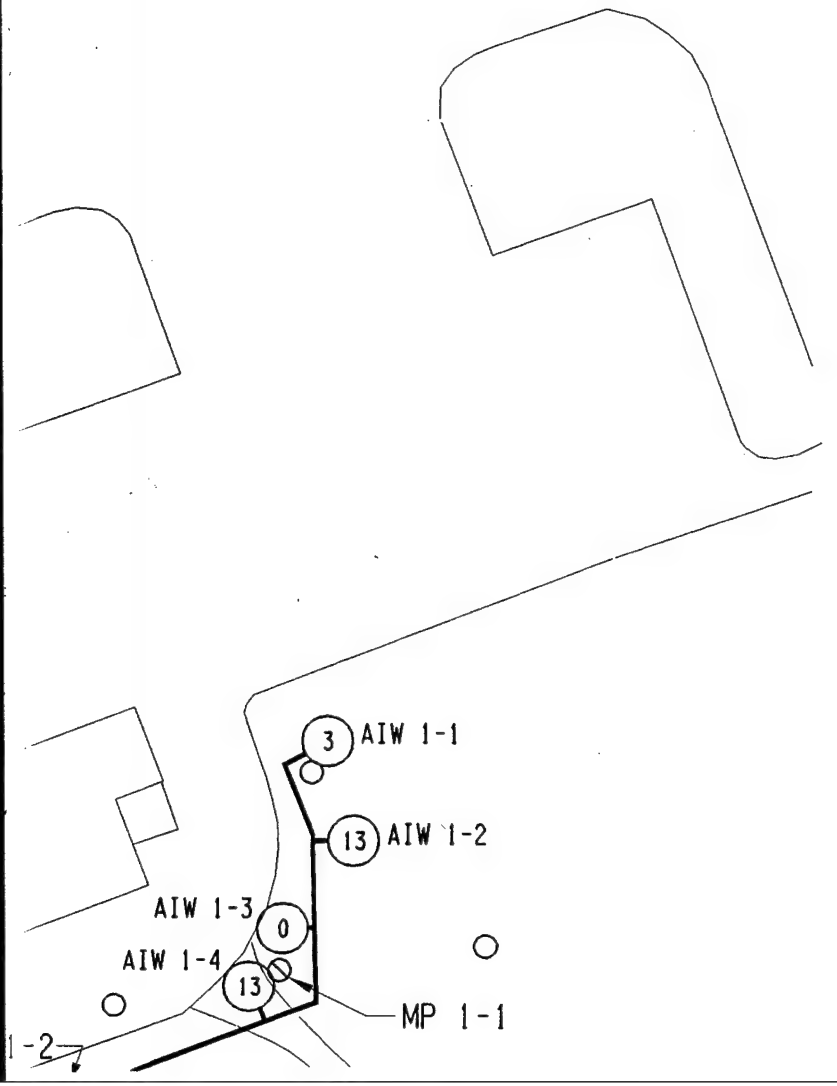
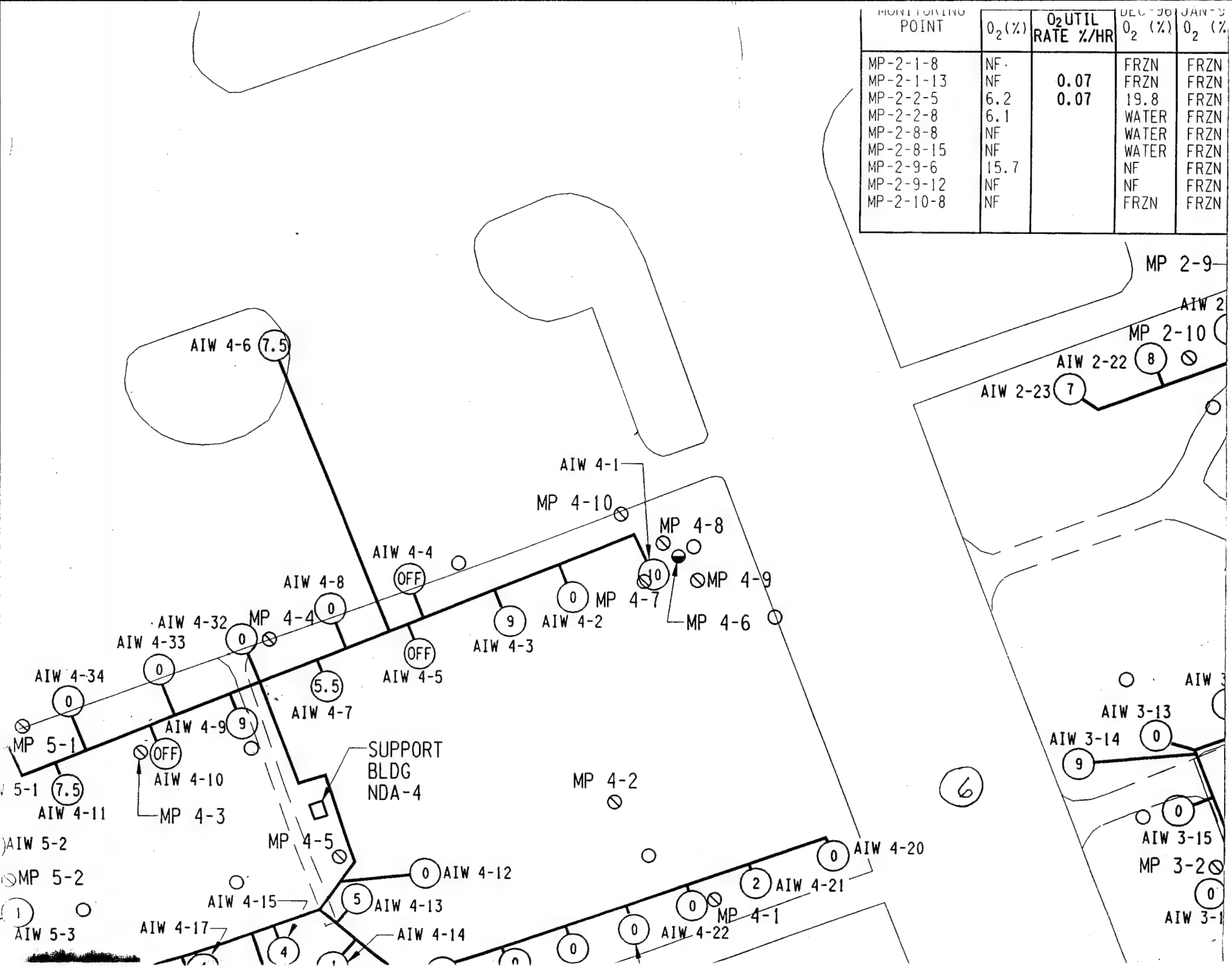
BLDG 8633
SUPPORT
BLDG
NDA-1
AIW 1-7
MP
0

SIZE E

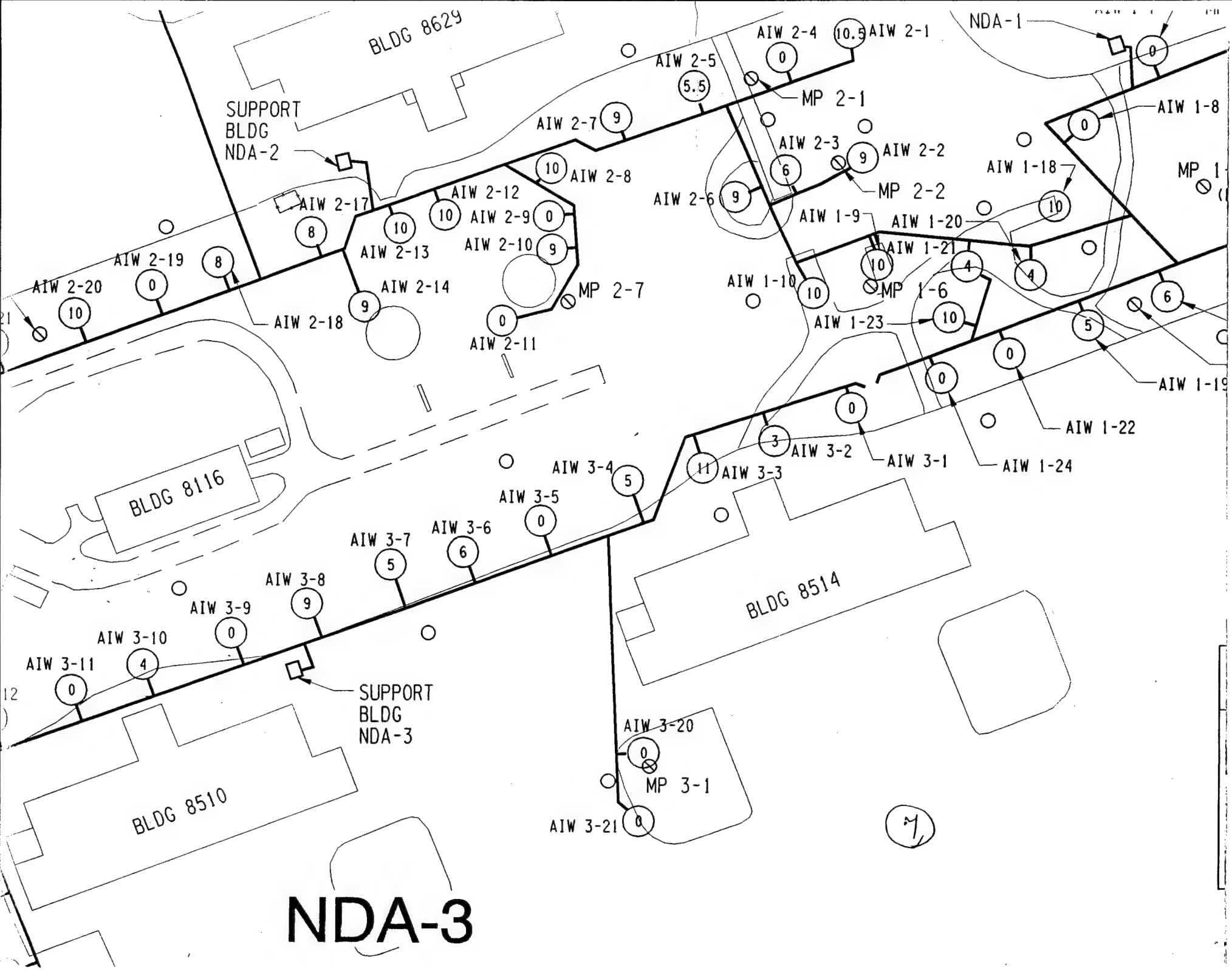


4


Bldg 8621
AIW 4-35
AIW 4-36
13.5
0
A
5
SUPPORT
BLDG
NDA-5
BLDG 8121



MONITORING POINT	O_2(%)	O_2 UTIL RATE %/HR	DEC-96 O_2 (%)	JAN-9 O_2 (%
MP-2-1-8	NF		FRZN	FRZN
MP-2-1-13	NF	0.07	FRZN	FRZN
MP-2-2-5	6.2	0.07	19.8	FRZN
MP-2-2-8	6.1		WATER	FRZN
MP-2-8-8	NF		WATER	FRZN
MP-2-8-15	NF		WATER	FRZN
MP-2-9-6	15.7		NF	FRZN
MP-2-9-12	NF		NF	FRZN
MP-2-10-8	NF		FRZN	FRZN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10.5
AIW 2-1
AIW 2-5
5.5
MP 2-1
AIW 2-7
9
AIW 2-3
9
AIW 2-2
MP 2-2
AIW 2-8
10
AIW 2-6
9
AIW 2-17
8
AIW 2-12
10
AIW 2-9
0
AIW 2-10
9
MP 2-7
AIW 2-13
10
AIW 2-19
8
AIW 2-20
10
0
AIW 2-14
9
AIW 2-18
AIW 2-11
0
NDA-1
0
AIW 1-8
0
AIW 1-18
10
MP 1
AIW 1-9
AIW 1-20
AIW 1-21
10
4
4
AIW 1-10
10
MP 1-6
AIW 1-23
10
6
5
AIW 1-19
0
0
AIW 1-22
AIW 1-24
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AIW 3-1
3
AIW 3-2
11
AIW 3-3
AIW 3-4
5
AIW 3-5
0
AIW 3-6
6
AIW 3-7
5
AIW 3-8
9
AIW 3-9
0
AIW 3-10
4
AIW 3-11
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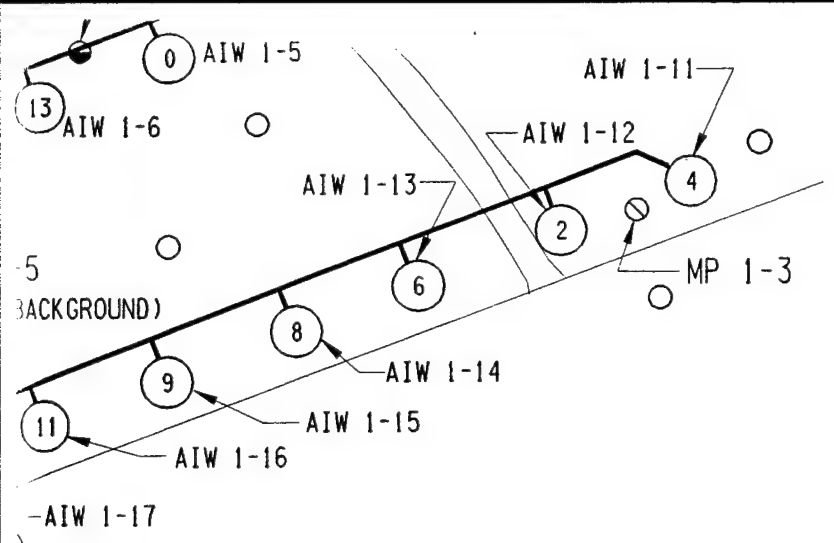
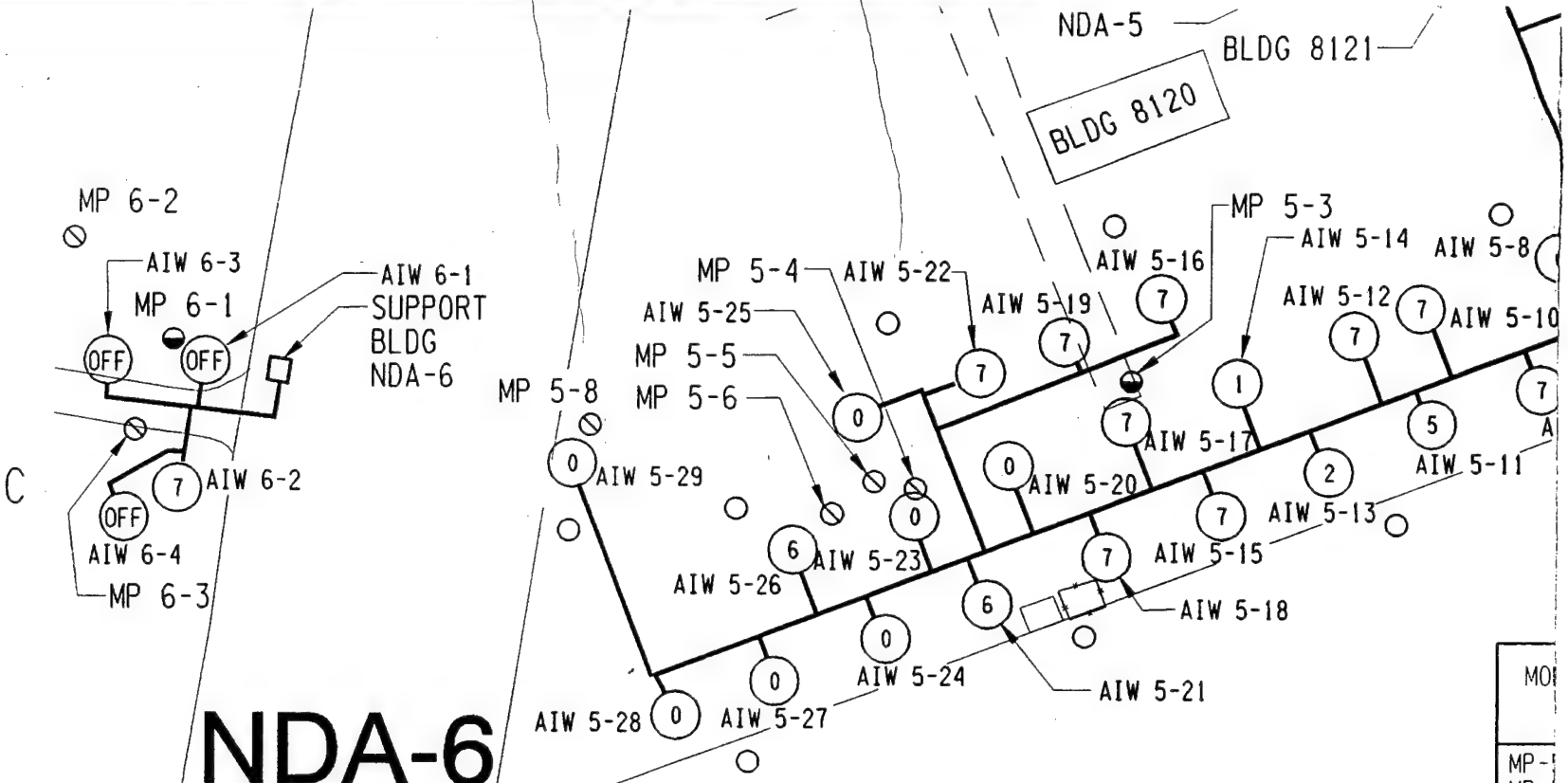
NDA-3



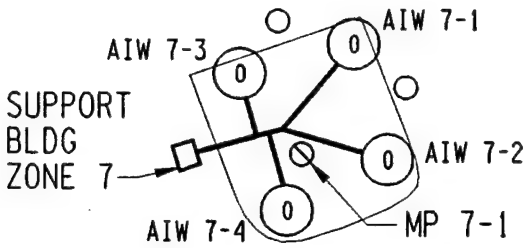
NDA-1

MONITORING POINT	SEP-96 O_2(%)	SEP-96 O_2 UTIL RATE %/HR	DEC-96 O_2 (%)	JAN-97 O_2 (%)
MP1-1-6.5	11.9		WATER	FRZN
MP1-1-13.5	WATER		WATER	FRZN
MP-1-2-7			13.4	17.7
MP-1-3-5.5	12.9		NF	FRZN
MP-1-3-11.5	NF		NF	FRZN
MP-1-4-8	3.0	4.2	1.8	FRZN
MP-1-4-13	NF		WATER	FRZN
MP-1-5BG-7	NF		FRZN	FRZN
MP-1-6-5	1.2	4.0	FRZN	FRZN
MP-1-6-8	0.7	5.1	FRZN	FRZN



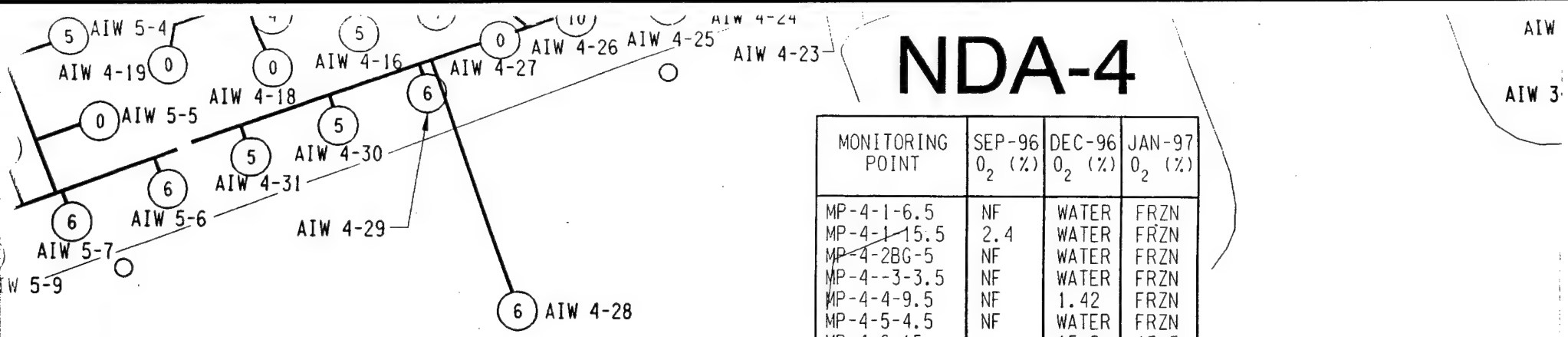
NDA-6

MONITORING POINT	SEP-96 O_2 (%)	SEP-96 O_2 UTIL RATE %/HR	DEC-96 O_2 (%)	JAN-97 O_2 (%)
MP-6-1-4 MP-6-2BG-7 MP-6-3-8.5	NF 12.5	0.014	2.6 14.3 WATER	0.9 FRZN FRZN



NDA-7

MONITORING POINT	SEP-96 O_2 (%)	DEC-96 O_2 (%)	JAN-97 O_2 (%)
MP7-1-7.5	NF	WATER	FRZN



NDA-4

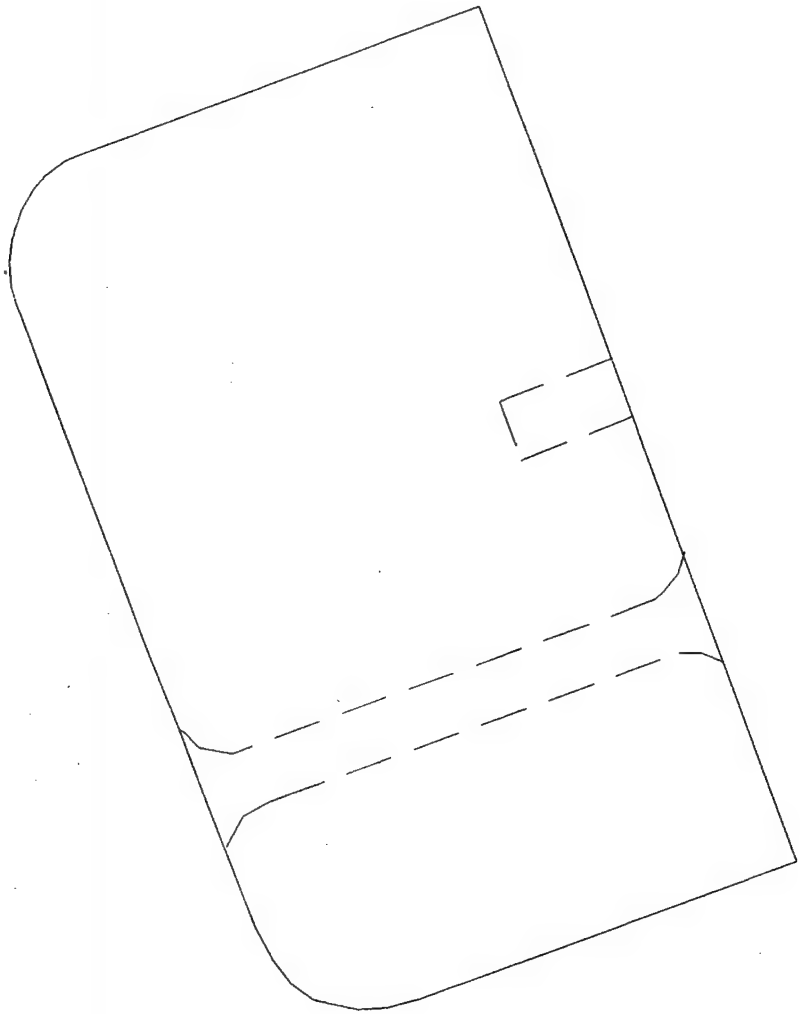
MONITORING POINT	SEP-96 O_2 (%)	DEC-96 O_2 (%)	JAN-97 O_2 (%)
MP-4-1-6.5	NF	WATER	FRZN
MP-4-1-15.5	2.4	WATER	FRZN
MP-4-2BG-5	NF	WATER	FRZN
MP-4--3-3.5	NF	WATER	FRZN
MP-4-4-9.5	NF	1.42	FRZN
MP-4-5-4.5	NF	WATER	FRZN
MP-4-6-15		15.9	15.5
MP-4-7-7.5	NF	NF	FRZN
MP-4-7-14.5	NF	NF	FRZN
MP-4-8-7.5	NF	NF	FRZN
MP-4-8-14.5	NF	NF	FRZN
MP-4-9-8	NF	NF	FRZN
MP-4-9-15.5	NF	NF	FRZN
MP-4-10-7.5	NF	NF	FRZN
MP-4-10-14.5	NF	NF	FRZN

NDA-5

TORING INT	SEP-96 O_2(%)	SEP-96 O_2 UTIL RATE %/HR	DEC-96 O_2 (%)	JAN-97 O_2 (%)
1-9.5	0.9	7.2	3.6	FRZN
2-3.5	NF		FRZN	FRZN
3-O_2			MALF	MALF
4-7.5	9	0.05	NF	FRZN
5-7	NF		FRZN	FRZN
6-5.5	NF		WATER	FRZN
-8-3	NF		FRZN	FRZN

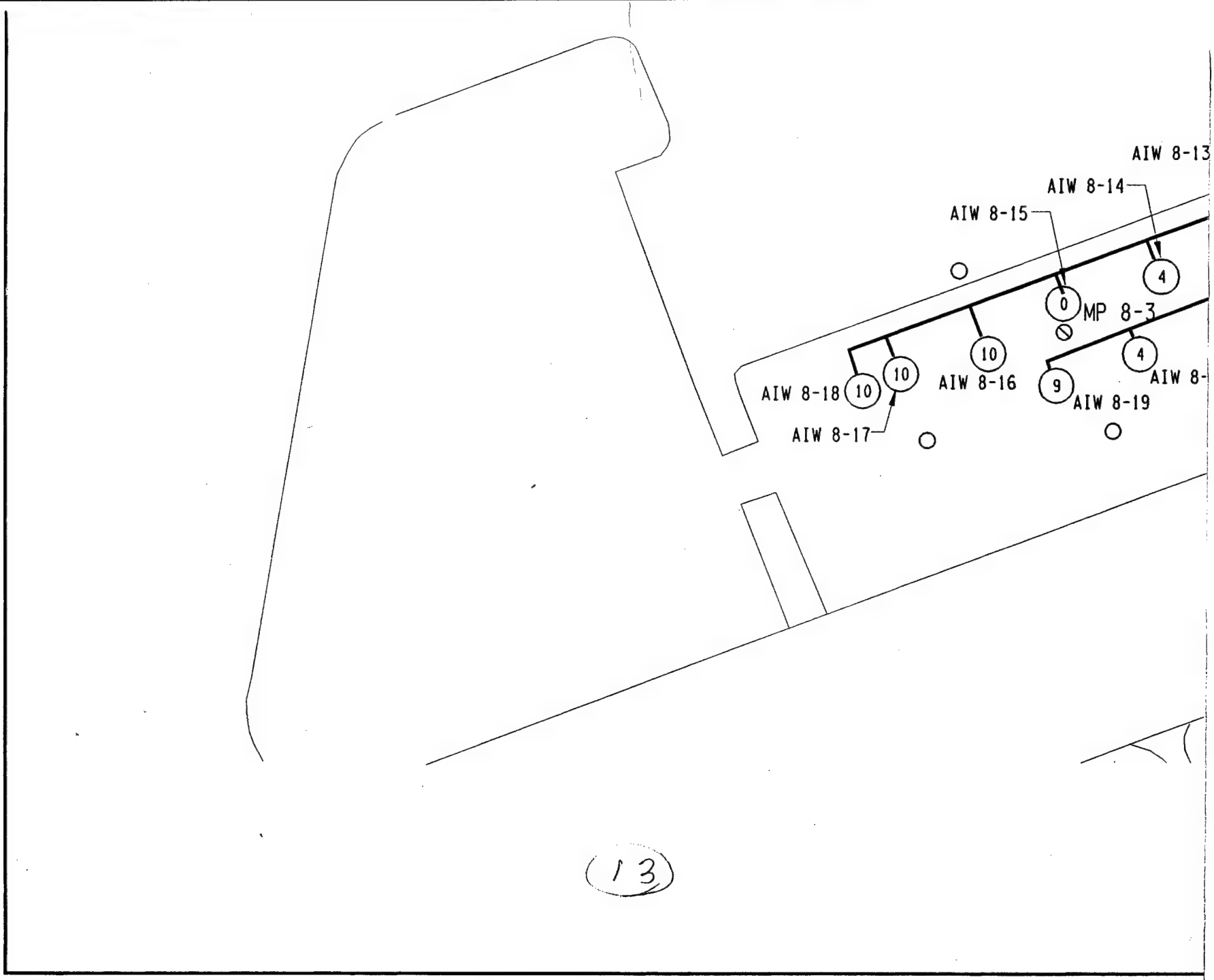
AIW 3-18

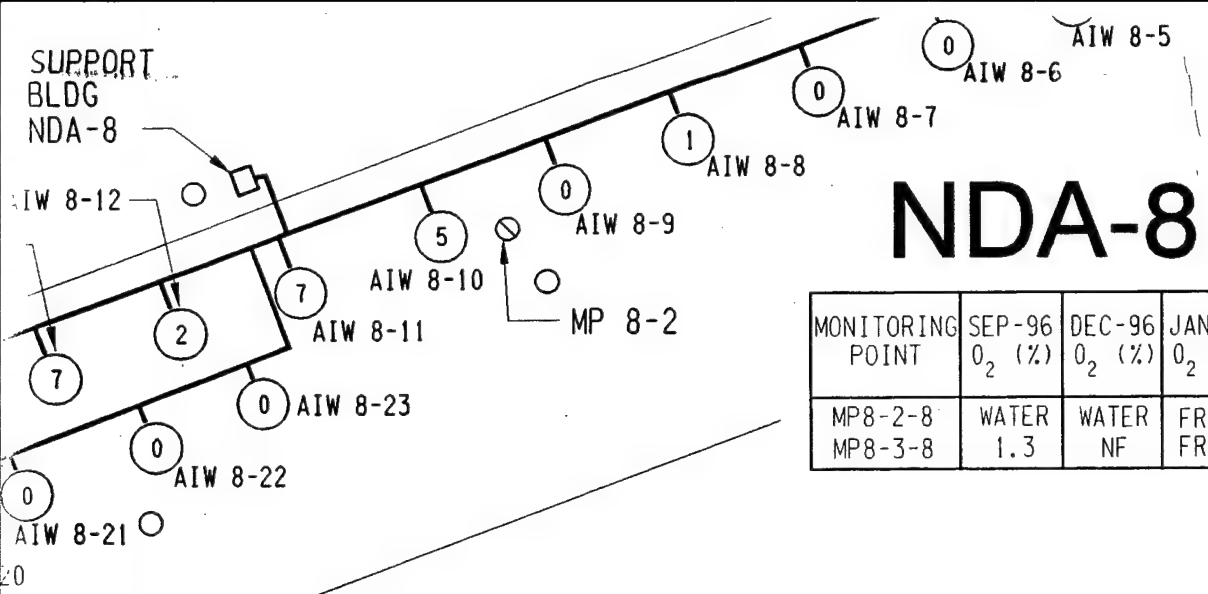
MONITORING POINT	SEP-96 O_2 (%)	DEC-96 O_2 (%)	JAN-97 O_2 (%)
MP-3-1-5.5	NF	FRZN	FRZN
MP-3-1-11.5	WATER	FRZN	FRZN
MP-3-2-8	NF	WATER	FRZN
MP-3--2-14	NF	FRZN	FRZN



(12)

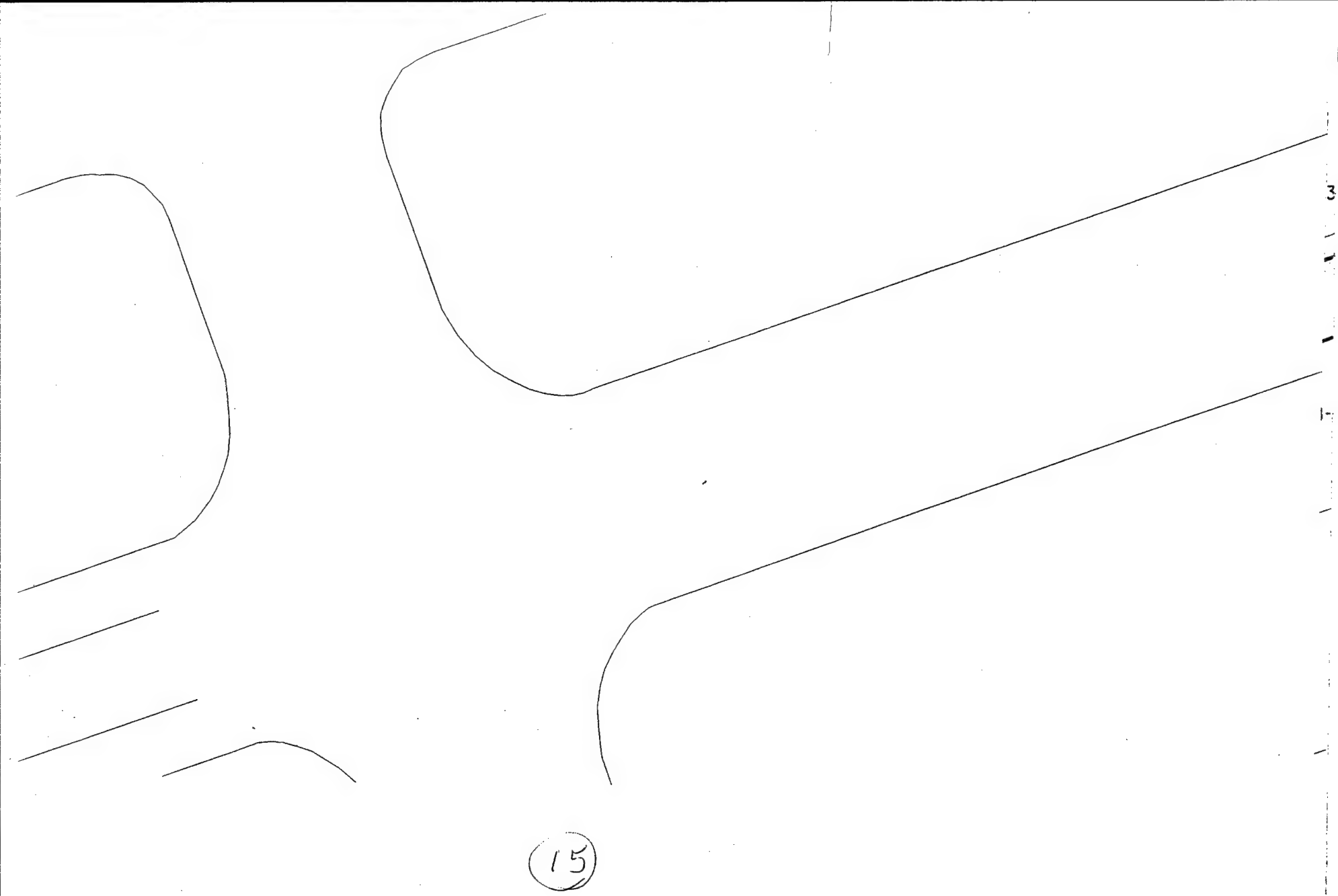
LEGEND


AIW 8-13
AIW 8-14
AIW 8-15
4
0
MP 8-3
10
4
AIW 8-18
10
10
AIW 8-16
9
AIW 8-19
AIW 8-17



NDA-8

MONITORING POINT	SEP-96 O_2 (%)	DEC-96 O_2 (%)	JAN-97 O_2 (%)
MP8-2-8	WATER	WATER	FRZN
MP8-3-8	1.3	NF	FRZN



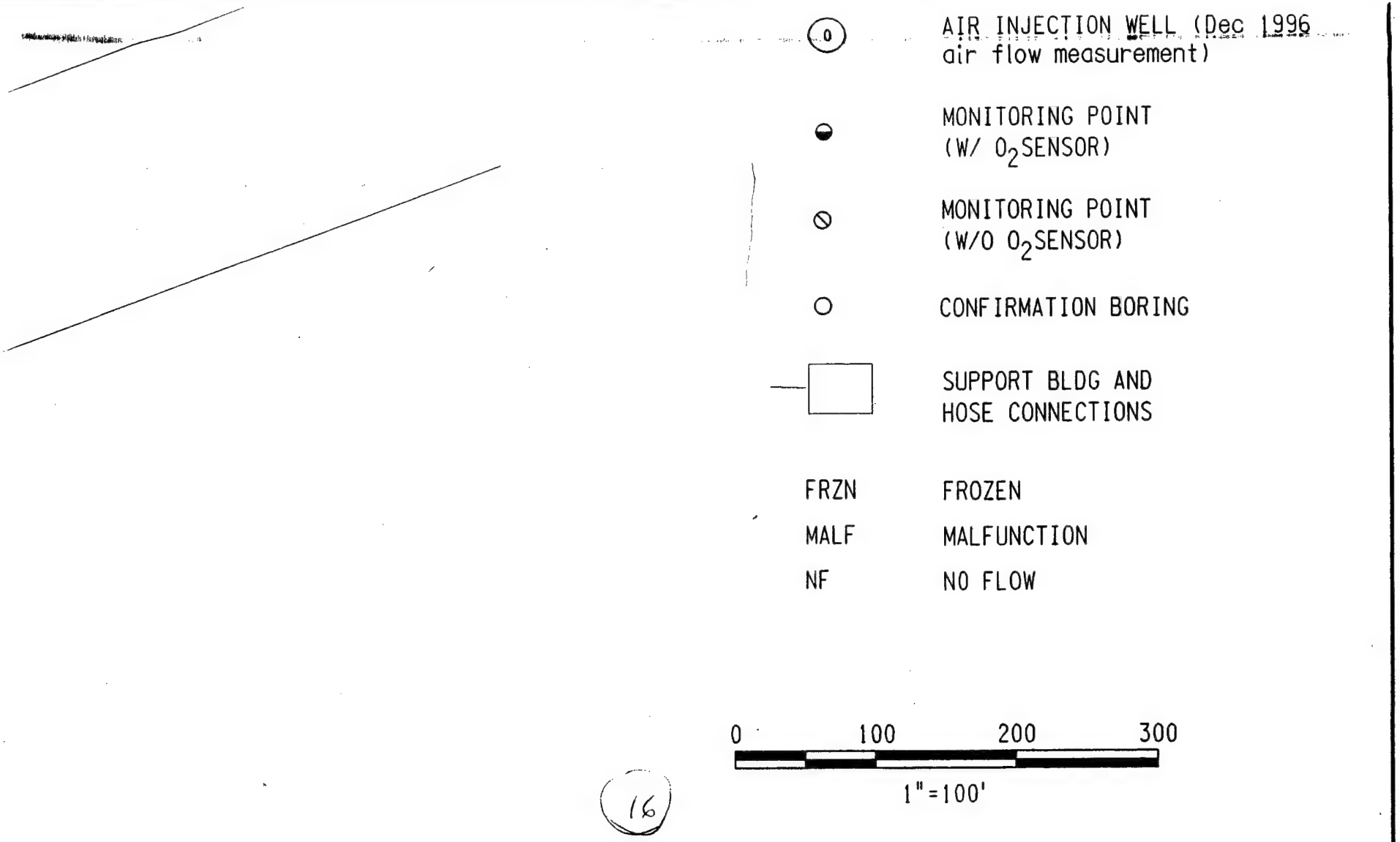


FIGURE 3-17
NDA BIOVENT SYSTEMS LAYOUT

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Table 3 - 9 NDA-1 Air Flow and Monitoring Point Data

Air Injection Well	Screen Interval top[6]	Screen Interval bottom[6]	Overburden Pressure[1] (psi)	Design Air Flow (scfm)	Individual Well Head Flow (scfm)[2] September 1996	October 1996	November 1996	December 1996	January 1997
AIW-1	12	22	8.3	15.0				3.0	2.0
AIW-2	6	21	4.2	14.0				13.0	13.0
AIW-3	13	24	9.0	13.0				0.0	0.0
AIW-4	7	18	4.9	13.0				13.0	13.0
AIW-5	11.3	21.3	7.8	13.0				0.0	0.0
AIW-6	18.75	29.75	13.0	13.0				13.0	13.0
AIW-7	15	30	10.4	13.0				0.0	0.0
AIW-8	16	26	11.1	13.0				0.0	0.0
AIW-9	12	23	8.3	10.0				10.0	8.0
AIW-10	12	23	8.3	10.0				10.0	10.0
AIW-11	17	28	11.8	12.0				4.0	4.0
AIW-12	16	27	11.1	12.0				2.0	4.0
AIW-13	16	27	11.1	12.0				6.0	8.0
AIW-14	15	26	10.4	12.0				8.0	6.0
AIW-15	10	21	6.9	11.0				9.0	9.5
AIW-16	13	24	9.0	11.0				11.0	11.0
AIW-17	14	25	9.7	11.0				6.0	6.0
AIW-18	14	24	9.7	11.0				10.0	9.5
AIW-19	14	25	9.7	11.0				5.0	4.5
AIW-20	12.5	23.5	8.7	11.0				4.0	5.0
AIW-21	12	23	8.3	10.0				4.0	4.0
AIW-22	13	24	9.0	10.0				0.0	0.0
AIW-23	13	24	9.0	10.0				10.0	10.0
AIW-24	13	24	9.0	10.0				0.0	0.0
Total air flow:				281.0				141.0	140.5
Blower Information									
Date:								12/9/96	1/6/97
Time:								1030	0800
Exit Temperature (°F):								58	70
Pressure (psi):								3.1	3

Monitoring Point	Screen Interval (ft bgs) top	bottom		Soil Gas Sampling Results[2] September 1996[3] O (%)	CO (%)	TVH (ppmv)	October 1996 O (%)	CO (%)	TVH (ppmv)	November 1996 O (%)	CO (%)	TVH (ppmv)	December 1996 O (%)	CO (%)	TVH (ppmv)	January 1997 O (%)	CO (%)	TVH (ppmv)
MP 1-1-6.5	6.5	7		11.9	4.1	16								Water			Frozen	
MP 1-1-13.5	13.5	14			Water in line									Water			Frozen	
MP 1-2-7-R					Oxygen sensor (not installed)													
MP 1-2-7-M					Oxygen sensor (not installed)													
MP 1-2-7-L	7	7	O_2 Sensor - On 12/10/96										13.4[4]	na	na	17.7[4]	na	na
MP 1-3-5.5	5.5	6		12.9	4.5	15								No flow			Frozen	
MP 1-3-11.5	11.5	12			No flow									No flow			Frozen	
MP 1-4-8	8	8.5	O_2 Util. Rate = 4.2%/hr[5]	3.0	17.0	>1000							1.8	13.0			Frozen	
MP 1-4-13	13	13.5			No flow									Water			Frozen	
MP 1-5BG-7	7	7.5	Background location		No flow									Frozen			Frozen	
MP 1-6-5	5	5.5	O_2 Util. Rate = 4.0%/hr[5]	1.2	11.8	>10000								Frozen			Frozen	
MP 1-6-8	8	8.5	O_2 Util. Rate = 5.1%/hr[5]	0.7	13.3	6750								Frozen			Frozen	

[1] Maximum pressure before potential for fracturing of soil. Calculated at top of screen assuming density of soil is 100 lbs/ft^3.
[2] Began data collection in December 1996.
[3] Prestartup samples.
[4] O_2 result represents average for month.
[5] Test performed on 10/3/96.
[6] Measured from top of casing.
na = not applicable

Table 3 - 10 NDA-2 Air Flow and Monitoring Point Data

Air Injection Well	Screen Interval top[5]	Screen Interval bottom[5]	Overburden Pressure[1] (psi)	Design Air Flow (scfm)	Individual Well Head Flow (scfm)[2] September 1996	October 1996	November 1996	December 1996	January 1997
AIW-1	14	25	9.7	11.0				10.5	10.0
AIW-2	11	22	7.6	9.0				9.0	8.0
AIW-3	7	18	4.9	11.0				6.0	7.5
AIW-4	11	22	7.6	9.0				0.0	0.0
AIW-5	13.5	23.5	9.4	11.0				5.5	5.5
AIW-6	10	21	6.9	9.0				9.0	9.0
AIW-7	13	24	9.0	10.0				9.0	8.5
AIW-8	10.5	21.5	7.3	10.0				10.0	10.0
AIW-9	6	13	4.2	12.0				0.0	0.0
AIW-10	11	22	7.6	9.0				9.0	9.0
AIW-11	4	15	2.8	9.0				0.0	0.0
AIW-12	8	19	5.6	10.0				10.0	10.0
AIW-13	12	23	8.3	10.0				10.0	10.0
AIW-14	11	22	7.6	9.0				9.0	9.0
AIW-15	9	19	6.3	12.0				12.0	12.0
AIW-16	10	20	6.9	12.0				0.0	0.0
AIW-17	9	20	6.3	8.0				8.0	8.0
AIW-18	9	20	6.3	8.0				8.0	8.0
AIW-19	6	15	4.2	10.0				0.0	0.0
AIW-20	9.5	20.5	6.6	10.0				10.0	10.0
AIW-21	9	20	6.3	10.0				5.0	5.0
AIW-22	8	19	5.6	8.0				8.0	8.0
AIW-23	7	18	4.9	7.0				7.0	7.0
Total air flow:				224.0				155.0	154.5
Blower Information									
Date:								12/9/96	1/6/97
Time:								1230	0800
Exit Temperature (°F):								45	56
Pressure (psi):								4.4	2.5

Monitoring Point	Screen Interval (ft bgs) top	bottom		Soil Gas Sampling Results[2] September 1996[3] O (%)	CO (%)	TVH (ppmv)	October 1996 O (%)	CO (%)	TVH (ppmv)	November 1996 O (%)	CO (%)	TVH (ppmv)	December 1996 O (%)	CO (%)	TVH (ppmv)	January 1997 O (%)	CO (%)	TVH (ppmv)
MP 2-1-8	8	8.5		No flow, mud										Frozen			Frozen	
MP 2-1-13	13	13.5		No flow										Frozen			Frozen	
MP 2-2-5	5	5.5	O_2 Util. Rate = 0.07%/hr[4]	6.2	11.5	0							19.8	0.0	103		Frozen	
MP 2-2-8	8	8.5	O_2 Util. Rate = 0.07%/hr[4]	6.1	11.5	0								Water			Frozen	
MP 2-7-O_2-R			O_2 Sensor	Oxygen sensor (not installed)														
MP 2-7-O_2-L			O_2 Sensor	Oxygen sensor (not installed)														
MP 2-8-8	8	8.5		No flow										Water			Frozen	
MP 2-8-15	15	15.5		No flow										Water			Frozen	
MP 2-9-6	6	6.5		15.7	1.3	9800								No flow			Frozen	
MP 2-9-12	12	12.5		No flow										No flow			Frozen	
MP 2-10-8	8	8.5		No flow										Frozen			Frozen	

[1] Maximum pressure before potential for fracturing of soil. Calculated at top of screen assuming density of soil is 100 lbs/ft^3.
[2] Began data collection in December 1996.
[3] Prestartup samples.
[4] Test performed on 10/4/96.
[5] Measured from top of casing.

Table 3 - 11 NDA-3 Air Flow and Monitoring Point Data

Air Injection Well	Screen Interval top[4]	Screen Interval bottom[4]	Overburden Pressure[1] (psi)	Design Air Flow (scfm)	Individual Well Head Flow (scfm)[2] September 1996	October 1996	November 1996	December 1996	January 1997
AIW-1	18	28	12.5	11				0.0	4.0
AIW-2	18	28	12.5	11				3.0	1.0
AIW-3	18	28	12.5	11				11.0	11.0
AIW-4	11	21	7.6	5				5.0	5.0
AIW-5	13	23	9.0	5				0.0	0.0
AIW-6	9	19	6.3	6				6.0	6.0
AIW-7	8	18	5.6	5				5.0	5.0
AIW-8	6.5	16.5	4.5	9				9.0	9.0
AIW-9	14	24	9.7	10				0.0	0.0
AIW-10	16	26	11.1	10				4.0	4.0
AIW-11	7	25.5	4.9	10				0.0	0.0
AIW-12	16	26	11.1	10				0.0	0.0
AIW-13	16	26	11.1	10				0.0	0.0
AIW-14	15	25	10.4	9				9.0	9.0
AIW-15	15	25	10.4	9				0.0	0.0
AIW-16	15	25	10.4	9				0.0	0.0
AIW-17	14	25	9.7	9				0.0	0.0
AIW-18	15	25	10.4	9				0.0	0.0
AIW-19	15	25	10.4	9				0.0	0.0
AIW-20	18	28	12.5	6				0.0	0.0
AIW-21	18	28	12.5	6				0.0	0.0
Total air flow:				179				52.0	54.0
Blower Information									
Date:								12/9/96	1/10/97
Time:								1400	0800
Exit Temperature (°F):								40	58
Pressure (psi):								5	2.9

Monitoring Point	Screen Interval (ft bgs) top	bottom	Soil Gas Sampling Results[2] September 1996[3] O2 (%)	CO2 (%)	TVH (ppmv)	October 1996 O2 (%)	CO2 (%)	TVH (ppmv)	November 1996 O2 (%)	CO2 (%)	TVH (ppmv)	December 1996 O2 (%)	CO2 (%)	TVH (ppmv)	January 1997 O2 (%)	CO2 (%)	TVH (ppmv)
MP 3-1-5.5	5.5	6	No flow									Frozen			Frozen		
MP 3-1-11.5	11.5	12	Water									Frozen			Frozen		
MP 3-2-8.0	8	8.5	No flow									Water			Frozen		
MP 3-2-14.0	14	14.5	No flow									Frozen			Frozen		

[1] Maximum pressure before potential for fracturing of soil. Calculated at top of screen assuming density of soil is 100 lbs/ft^3.
[2] Began data collection in December 1996.
[3] Prestartup samples.
[4] Measured from top of casing.

Table 3 - 12 NDA-4 Air Flow and Monitoring Point Data

Air Injection Well	Screen Interval top[3]	Screen Interval bottom[3]	Overburden Pressure[1] (psi)	Design Air Flow (scfm)	Individual Well Head Flow (scfm)[2] September 1996	October 1996	November 1996	December 1996	January 1997
AIW-1	14	24	9.7	10				10.0	10.0
AIW-2	8	18	5.6	9				0.0	0.0
AIW-3	6	16	4.2	9				9.0	9.0
AIW-4	11	21	7.6	9				OFF	OFF
AIW-5	11	21	7.6	9				OFF	OFF
AIW-6	8	18	5.6	9				7.5	7.0
AIW-7	11	21	7.6	9				5.5	7.0
AIW-8	9	19	6.3	9				0.0	0.0
AIW-9	8	18	5.6	9				9.0	9.0
AIW-10	8	18	5.6	9				OFF	OFF
AIW-11	7	17	4.9	8				7.5	8.0
AIW-12	6	12	4.2	5				0.0	0.0
AIW-13	6	12	4.2	5				5.0	5.0
AIW-14	6	13	4.2	5				1.0	4.0
AIW-15	6	11	4.2	4				4.0	5.0
AIW-16	6	12	4.2	5				5.0	5.0
AIW-17	6	11	4.2	4				4.0	4.0
AIW-18	6	12	4.2	5				0.0	0.0
AIW-19	6	12	4.2	5				0.0	0.0
AIW-20	16	26	11.1	11				0.0	0.0
AIW-21	12	22	8.3	11				2.0	1.0
AIW-22	15	25	10.4	10				0.0	0.0
AIW-23	15	25	10.4	10				0.0	0.0
AIW-24	15	25	10.4	10				0.0	0.0
AIW-25	15	25	10.4	10				0.0	0.0
AIW-26	7	15	4.9	10				10.0	10.0
AIW-27	6	14	4.2	6				0.0	0.0
AIW-28	8	16	5.6	7				6.0	7.0
AIW-29	6	14	4.2	6				6.0	6.0
AIW-30	6	13	4.2	5				5.0	5.0
AIW-31	6	13	4.2	5				5.0	5.0
AIW-32	12	22	8.3	5				0.0	0.0
AIW-33	16	26	11.1	5				0.0	0.0
AIW-34	16	26	11.1	5				0.0	0.0
AIW-35	16	26	11.1	5				0.0	0.0
AIW-36	5	8	3.5	5				13.5	13.0
Total air flow:				263				115.0	120.0
Blower Information									
Date:								12/10/96	1/9/97
Time:								1230	0800
Exit Temperature (°F):								63	20
Pressure (psi):								3	2.8

Monitoring Point	Screen Interval top	Screen Interval bottom		Soil Gas Sampling Results[2] September 1996[3] O (%)	CO (%)	TVH (ppmv)	October 1996 O (%)	CO (%)	TVH (ppmv)	November 1996 O (%)	CO (%)	TVH (ppmv)	December 1996 O (%)	CO (%)	TVH (ppmv)	January 1997 O (%)	CO (%)	TVH (ppmv)
MP 4-1-7.0	6.5	7			No flow									Water			Frozen	
MP 4-1-16.0	15.5	16		2.4	7.4	90000								Water			Frozen	
MP 4-2BG-5.0	5	10	Background location		No flow									Water			Frozen	
MP 4-3-4.0	3.5	4			No flow									Water			Frozen	
MP 4-4-10.0	9.5	10			No flow								14.2	16.2	4.6%		Frozen	
MP 4-5-5.0	4.5	5			No flow									Water			Frozen	
MP 4-6-15	15	15	O_2 Sensor - On 12/10/96										15.9[5]	na	na	15.5[5]	na	na
MP 4-7-8.0	7.5	8			No flow									No flow			Frozen	
MP 4-7-15.0	14.5	15			No flow									No flow			Frozen	
MP 4-8-8.0	7.5	8			No flow									No flow			Frozen	
MP 4-8-15.0	14.5	15			No flow									No flow			Frozen	
MP 4-9-8.5	8	8.5			No flow									No flow			Frozen	
MP 4-9-16.0	15.5	16			No flow									No flow			Frozen	
MP 4-10-8.0	7.5	8			No flow									No flow			Frozen	
MP4-10-15.0	14.5	15			No flow									No flow			Frozen	

[1] Maximum pressure before potential for fracturing of soil. Calculated at top of screen assuming density of soil is 100 lbs/ft^3.
[2] Began data collection in December 1996.
[3] Prestartup samples.
[4] Measured from top of casing.
[5] O_2 result represents average for month.
na = not applicable

Table 3 - 13 NDA-5 Air Flow and Monitoring Point Data

Air Injection Well	Screen Interval top[4]	Screen Interval bottom[4]	Overburden Pressure[1] (psi)	Design Air Flow (scfm)	Individual Well Head Flow (scfm)[2] September 1996	October 1996	November 1996	December 1996	January 1997
AIW-1	5	8	3.5	9				0.0	0.0
AIW-2	5	8	3.5	9				0.0	0.0
AIW-3	6	9	4.2	9				1.0	0.0
AIW-4	6	11	4.2	5				5.0	5.0
AIW-5	8	14	5.6	6				0.0	0.0
AIW-6	7	13	4.9	6				6.0	6.0
AIW-7	7	13	4.9	6				6.0	6.0
AIW-8	7	13	4.9	6				6.0	6.0
AIW-9	7	13	4.9	7				7.0	6.7
AIW-10	7	13	4.9	7				7.0	7.0
AIW-11	6	12	4.2	6				5.0	6.0
AIW-12	7	13	4.9	7				7.0	7.0
AIW-13	6	11	4.2	6				2.0	4.0
AIW-14	6	11	4.2	6				1.0	2.0
AIW-15	6	10	4.2	7				7.0	7.0
AIW-16	6	10	4.2	7				7.0	7.0
AIW-17	6	11	4.2	7				7.0	7.0
AIW-18	6	10	4.2	7				7.0	7.0
AIW-19	6	10	4.2	7				7.0	7.0
AIW-20	6	10	4.2	7				0.0	0.0
AIW-21	6	9	4.2	6				6.0	6.0
AIW-22	6	10	4.2	7				7.0	7.0
AIW-23	6	11	4.2	6				0.0	0.0
AIW-24	5	8	3.5	6				0.0	4.5
AIW-25	6	9	4.2	6				0.0	0.0
AIW-26	5	8	3.5	6				6.0	6.0
AIW-27	4	7	2.8	5				0.0	5.0
AIW-28	4	7	2.8	5				0.0	5.0
AIW-29	4	6	2.8	5				0.0	4.0
Total air flow:				189				107.0	128.2
Blower Information									
Date:								12/11/96	1/7/97
Time:								0800	0800
Exit Temperature (°F):								60	54
Pressure (psi):								3.6	2.75

Monitoring Point	Screen Interval (ft bgs) top	bottom		Soil Gas Sampling Results[2] September 1996[3] O (%)	CO (%)	TVH (ppmv)	October 1996 O (%)	CO (%)	TVH (ppmv)	November 1996 O (%)	CO (%)	TVH (ppmv)	December 1996 O (%)	CO (%)	TVH (ppmv)	January 1997 O (%)	CO (%)	TVH (ppmv)
MP 5-1-9.5	9.5	10	O_2 Util. Rate = 7.2%/hr[5]	0.9	37.4	>10000							3.6	15.4	nr		Frozen	
MP 5-2-3.5	3.5	4			No flow									Frozen			Frozen	
MP 5-3-7	7	7	O_2 Sensor - On 12/10/96											Malfunctioned - no data			Malfunctioned - no data	
MP 5-4-7.0	7	7.5	O_2 Util. Rate = 0.05%/hr[5]	9.0	7.8	4								No flow			Frozen	
MP 5-5-7.0	7	7.5			No flow									Frozen			Frozen	
MP 5-6-5.5	5.5	6			No flow									Water			Frozen	
MP 5-8-3.0	3	3.5			No flow									Frozen			Frozen	

[1] Maximum pressure before potential for fracturing of soil. Calculated at top of screen assuming density of soil is 100 lbs/ft^3.
[2] Began data collection in December 1996.
[3] Prestartup samples.
[4] Measured from top of casing.
[5] Test performed on 10/2/96.
nr = not recorded

Table 3 - 14 NDA-6 Air Flow and Monitoring Point Data

Air Injection Well	Screen Interval top[4]	Screen Interval bottom[4]	Overburden Pressure[1] (psi)	Design Air Flow (scfm)	Individual Well Head Flow (scfm)[2] September 1996	October 1996	November 1996	December 1996	January 1997
AIW-1	8	18	5.6	7				OFF	OFF
AIW-2	8	18	5.6	7				7.0	6.0
AIW-3	8	18	5.6	7				OFF	OFF
AIW-4	8	18	5.6	7				OFF	OFF
Total air flow:				28				7.0	6.0
Blower Information									
Date:								12/11/96	1/7/97
Time:								0900	1215
Exit Temperature (°F):								56	64
Pressure (psi):								3.2	2.2

Monitoring Point	Screen Interval top	Screen Interval bottom		Soil Gas Sampling Results[2] September 1996[3] O (%)	CO (%)	TVH (ppmv)	October 1996 O (%)	CO (%)	TVH (ppmv)	November 1996 O (%)	CO (%)	TVH (ppmv)	December 1996 O (%)	CO (%)	TVH (ppmv)	January 1997 O (%)	CO (%)	TVH (ppmv)
MP 6-1-4	4	4	O_2 Sensor - On 12/10/96										2.6[5]	na	na	0.9[5]	na	na
MP 6-2BG-7.0	7	12	Background location		No flow								14.3	1.3	9.0		Frozen	
MP 6-3-8.0	8	8.5	O_2 Util. Rate = 0.4%/hr[6]	12.5	3.7	3900								Water			Frozen	

[1] Maximum pressure before potential for fracturing of soil. Calculated at top of screen assuming density of soil is 100 lbs/ft^3.
[2] Began data collection in December 1996.
[3] Prestartup samples.
[4] Measured from top of casing.
[5] O_2 result represents average for month.
[6] Test performed on 10/1/96.

Table 3 - 15 NDA-7 Air Flow and Monitoring Point Data

Air Injection Well	Screen Interval top[4]	Screen Interval bottom[4]	Overburden Pressure[1] (psi)	Design Air Flow (scfm)	Individual Well Head Flow (scfm)[2] September 1996	October 1996	November 1996	December 1996	January 1997
AIW-1	6	21	4.2	9				0.0	0.0
AIW-2	6	21	4.2	9				0.0	0.0
AIW-3	6	21	4.2	9				0.0	0.0
AIW-4	6	21	4.2	9				0.0	0.0
Total air flow:				36				0.0	0.0
Blower Information									
Date:								12/11/96	1/7/97
Time:								0915	1045
Exit Temperature (°F):								44	50
Pressure (psi):								3.5	3.5

Monitoring Point	Screen Interval (ft bgs) top	bottom	Soil Gas Sampling Results[2] September 1996[3] O2 (%)	CO2 (%)	TVH (ppmv)	October 1996 O2 (%)	CO2 (%)	TVH (ppmv)	November 1996 O2 (%)	CO2 (%)	TVH (ppmv)	December 1996 O2 (%)	CO2 (%)	TVH (ppmv)	January 1997 O2 (%)	CO2 (%)	TVH (ppmv)
MP 7-1-7.0	7	7.5	No flow									Water			Frozen		

[1] Maximum pressure before potential for fracturing of soil. Calculated at top of screen assuming density of soil is 100 lbs/ft^3.
[2] Began data collection in December 1996
[3] Prestartup samples
[4] Measured from top of casing.

Table 3 - 16 NDA-8 Air Flow and Monitoring Point Data

Air Injection Well	Screen Interval		Overburden Pressure[1]	Design Air Flow	Individual Well Head Flow (scfm)[2]				
	top[4]	bottom[4]	(psi)	(scfm)	September 1996	October 1996	November 1996	December 1996	January 1997
AIW-1	14	26	9.7	10				0.0	0.0
AIW-2	14	26	9.7	10				0.0	0.0
AIW-3	13	25	9.0	10				0.0	0.0
AIW-4	13	25	9.0	10				0.0	0.0
AIW-5	12	24	8.3	10				0.0	0.0
AIW-6	12	24	8.3	10				0.0	0.0
AIW-7	11	23	7.6	9				0.0	0.0
AIW-8	10	22	6.9	8				1.0	0.0
AIW-9	11	23	7.6	7				0.0	0.0
AIW-10	10	22	6.9	6				5.0	6.0
AIW-11	9	21	6.3	7				7.0	7.0
AIW-12	8	20	5.6	7				2.0	4.0
AIW-13	9	21	6.3	7				7.0	7.0
AIW-14	7	19	4.9	8				4.0	6.0
AIW-15	7	19	4.9	9				0.0	0.0
AIW-16	7	19	4.9	10				10.0	10.0
AIW-17	6	18	4.2	10				10.0	10.0
AIW-18	6	18	4.2	10				10.0	10.0
AIW-19	11	23	7.6	9				9.0	9.0
AIW-20	11	23	7.6	8				4.0	7.0
AIW-21	9	21	6.3	8				0.0	0.0
AIW-22	10	22	6.9	7				0.0	0.0
AIW-23	12	24	8.3	7				0.0	0.0
Total air flow:				197				69.0	76.0
Blower Information									
Date:								12/11/96	1/7/97
Time:								0930	1230
Exit Temperature (°F):								42	55
Pressure (psi):								4.1	3.7

Monitoring Point	Screen Interval		Soil Gas Sampling Results[2]												
			September 1996[3]			October 1996			November 1996			December 1996			January 1997		
	top	bottom	O_2 (%)	CO_2 (%)	TVH (ppmv)	O_2 (%)	CO_2 (%)	TVH (ppmv)	O_2 (%)	CO_2 (%)	TVH (ppmv)	O_2 (%)	CO_2 (%)	TVH (ppmv)	O_2 (%)	CO_2 (%)	TVH (ppmv)
MP 8-1-O_2-R			Oxygen sensor (not installed)														
MP 8-1-O_2-L			Oxygen sensor (not installed)														
MP 8-2-8.0	8	8.5	No flow									Water			Frozen		
MP 8-3-8.0	8	8.5	16.4	3.5	1.5							No flow			Frozen		

[1] Maximum pressure before potential for fracturing of soil. Calculated at top of screen assuming density of soil is 100 lbs/ft^3.
[2] Began data collection in December 1996.
[3] Prestartup samples.
[4] Measured from top of casing.

The September soil gas results are used for initial conditions and also were used to determine locations for respiration tests. December airflow and September and December soil gas oxygen data have been presented for comparison in Figure 3-17.

A brief synopsis for each site is given below.

- **NDA #1**. 75 percent of 24 AIWs are accepting flow. Three out of the five MPs sampled in September had oxygen levels below 5 percent, indicating contaminated soils. Respiration tests performed at these three locations had an average oxygen utilization rate of 4.4 percent/hr, much higher than the rates seen at other sites (Figures 3-18 and 3-19). Only one MP yielded a gas sample in December, and the oxygen level was 1.8 percent. This could indicate that either the area is not being aerated or that the oxygen is being utilized quicker than it is being supplied.

- **NDA #2**. 78 percent of the 23 AIWs are accepting flow. None of the three MPs sampled in September had oxygen levels below 5 percent; however, two points had oxygen concentrations around 6 percent (6.1 and 6.2 percent). Respiration tests were performed at this location (both intervals) and oxygen utilization rates were found to be 0.07 percent/hr, indicative of background (uncontaminated) areas (Figure 3-20).

- **NDA #3**. 38 percent of the 21 AIWs are accepting flow. No soil gas samples could be collected from the four MPs either in September or December. Since no soil gas samples could be collected, no respiration tests were performed at this site.

- **NDA #4**. 50 percent of the 38 AIWs are accepting flow. Three of the AIWs with leaking seals will be repaired in the spring once the ground thaws. In September, only MP-4-1-16 yielded a gas sample. Oxygen concentrations were low (2.4 percent) and a respiration test was planned for this location. However, just prior to the beginning the test, the MP was sampled and water was encountered; therefore the test was abandoned.

- **NDA #5**. 76 percent of the 29 AIWs accepting flow. Respiration tests were run on MP-5-1-10 and MP-5-4-7 based on the September soil gas sampling event. Oxygen utilization rates from these tests were 7.2 and 0.05 percent/hr, respectively (Figure 3-21). The higher rate is indicative of an active microbial population that is limited by oxygen levels. The lower rate is typical of background (uncontaminated) conditions. A soil gas sample collected in December at MP-5-1-10 had an oxygen level of 3.6 percent. Based on the oxygen utilization rate at this location, it is uncertain whether the area is not being aerated or if the oxygen use is greater than supply.

- **NDA #6**. Only one of the four AIWs is operating. The remaining three AIWs were turned off upon the request of researchers at the University of Maine at Orono. Currently, a graduate student is doing a master's thesis on bioventing and has been granted use of NDA #6 for research purposes. Operation, therefore, is conducted in conjunction with research activities at the site. No modifications are anticipated to occur to this system. A respiration test was run on at MP-6-3-8 (background), and the oxygen utilization rate was determined to be 0.014 percent/hr (Figure 3-22).

Time[1] (hrs)	MP-4-8			
	O_2	CO_2	TVH	Helium
0	20.3	0.0	245	0.9
2	6.3	3.2		1.2
4	3.5	4.9		1.2

[1] Test began on 10/3/96 at 10:00

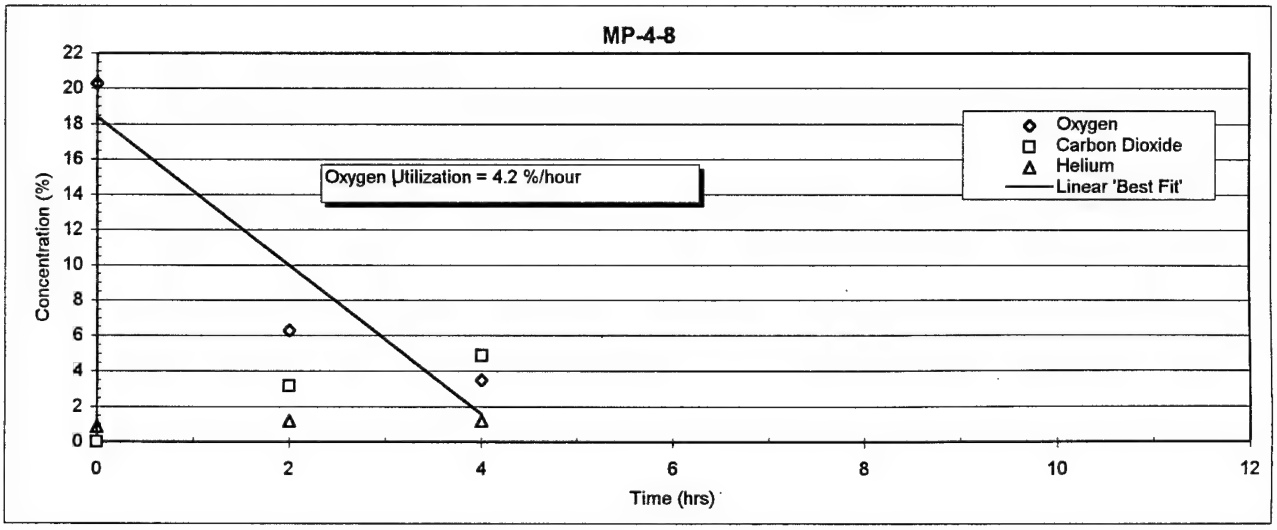
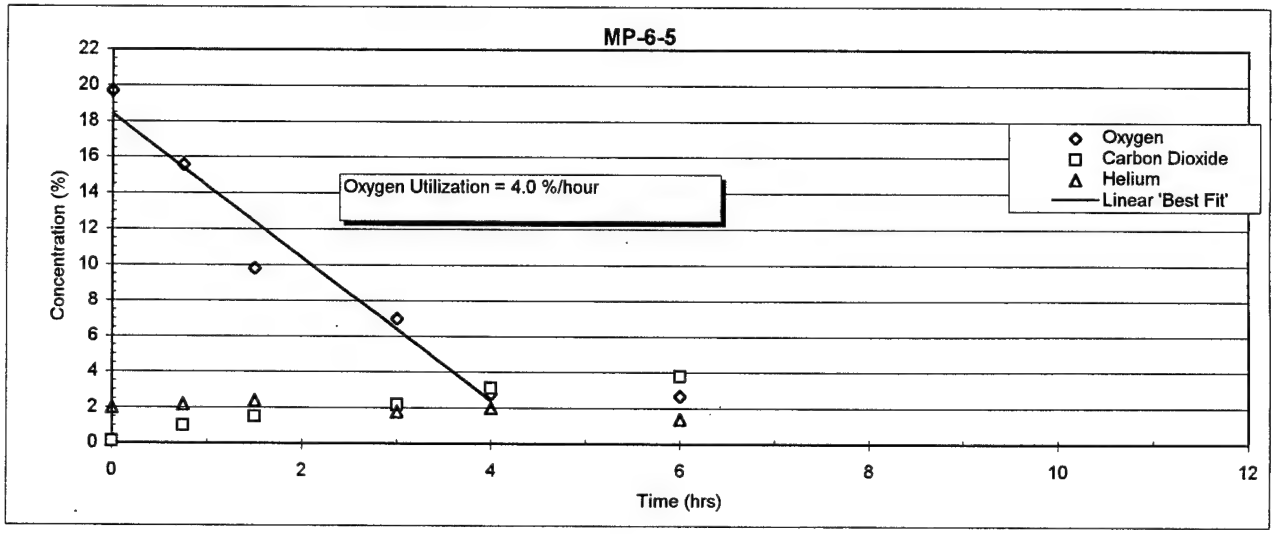


Figure 3 - 18 Pre-Startup Respiration Test Results for MP-4-8 at Nose Dock Area #1

Time[1] (hrs)	MP-6-5				MP-6-8			
	O_2	CO_2	TVH	Helium	O_2	CO_2	TVH	Helium
0	19.7	0.1	49	2.0	19.5	0.2	2700	2.1
0.75	15.6	1.0	440	2.2	15.0	1.3	19000	2.4
1.5	9.8	1.5	580	2.4	9.2	2.6	20000	2.4
3	7.0	2.2		1.8	4.2	2.5		1.6
4	2.8	3.1		2.0	5.1	4.0		1.9
6	2.7	3.8		1.4	3.0	5.0		1.9

[1] Test began on 10/3/96 at 08:00



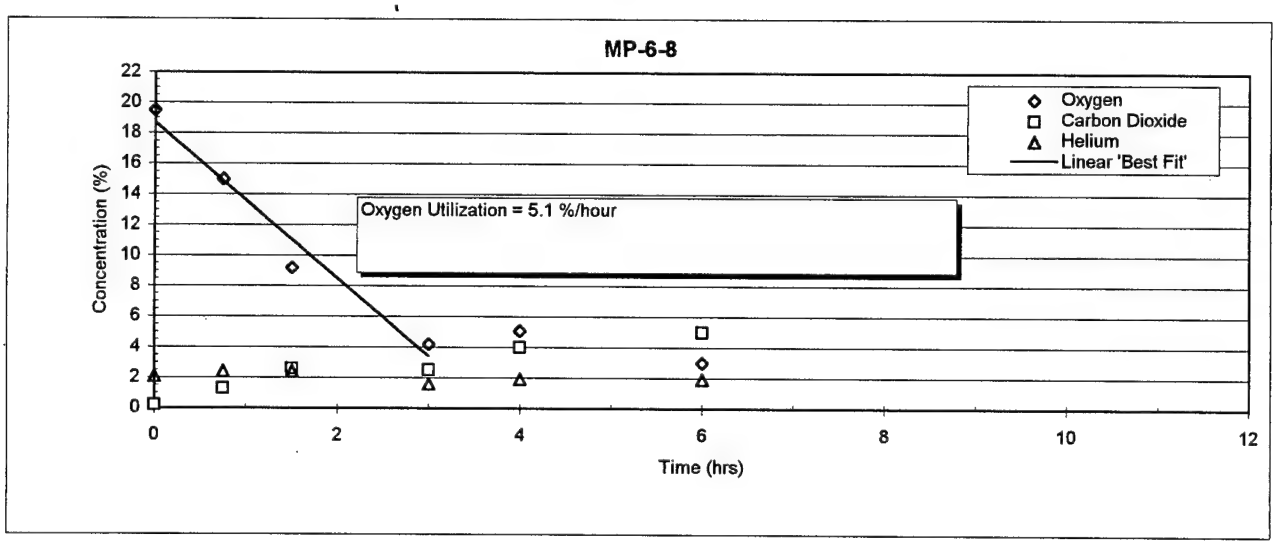
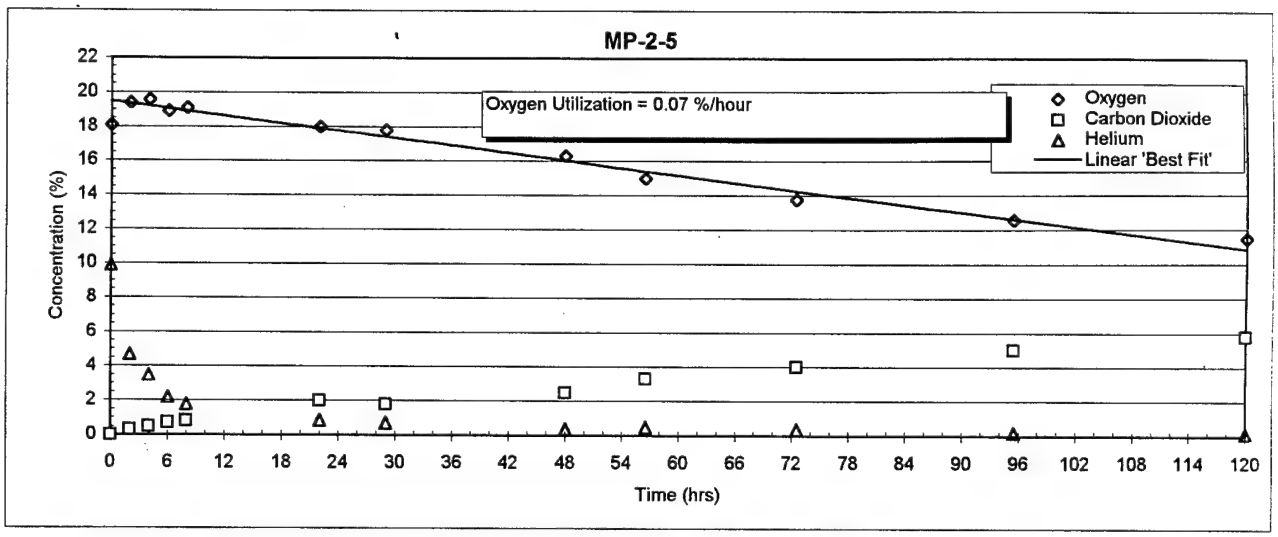


Figure 3 - 19 Pre-Startup Respiration Test Results for MP-6-5 and MP-6-8 at Nose Dock Area #1

Time[1]	MP-2-5				MP-2-8			
(hrs)	O_2	CO_2	TVH	Helium	O_2	CO_2	TVH	Helium
0	18.1	0.0	26	9.9	17.7	0.0	67	8.5
2	19.4	0.3	18	4.7	19.7	0.3	22	2.8
4	19.6	0.5	21	3.5	19.8	0.4	20	2.5
6	18.9	0.7	184	2.2	18.6	0.7	126	2.1
8	19.1	0.8		1.8	19.1	0.9		1.6
22	18.0	2.0	4	0.9	18.4	1.4	3	1.0
29	17.8	1.8	26	0.7	16.6	2.6	21	0.8
48	16.3	2.5	39	0.4	15.3	3.8	56	0.4
56.5	15.0	3.3	25	0.5	13.9	4.6	410	0.4
72.5	13.8	4.0	230	0.4	12.8	5.5	420	0.3
95.5	12.6	5.0	25	0.2	13.0	5.5	125	0.2
120	11.5	5.8	46	0.2	11.2	6.9		0.1

[1] Test began on 10/4/96 at 09:00



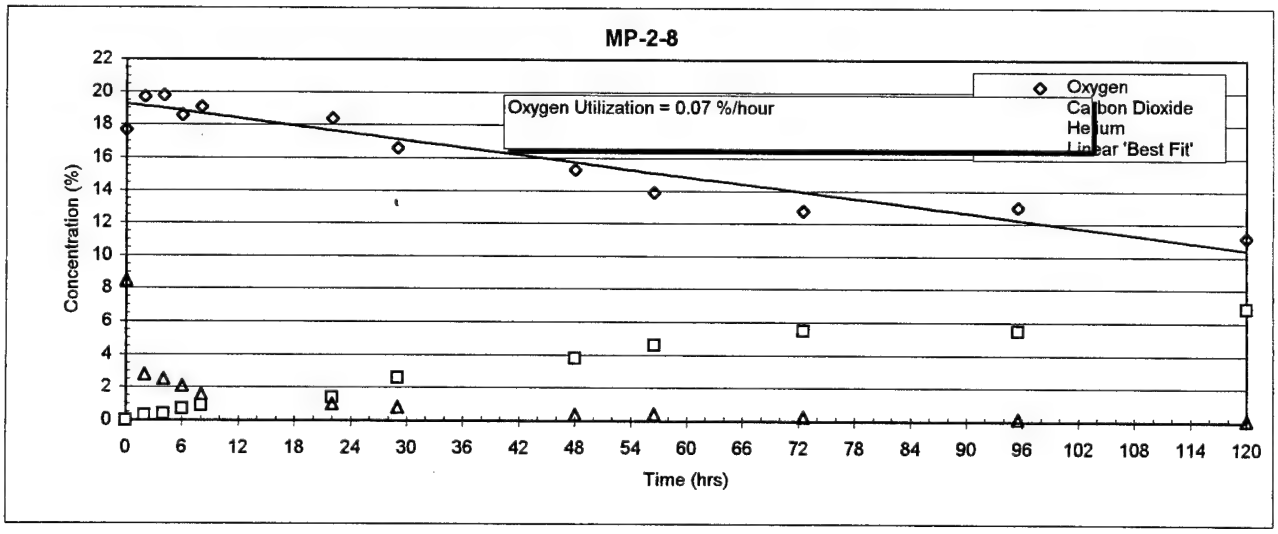
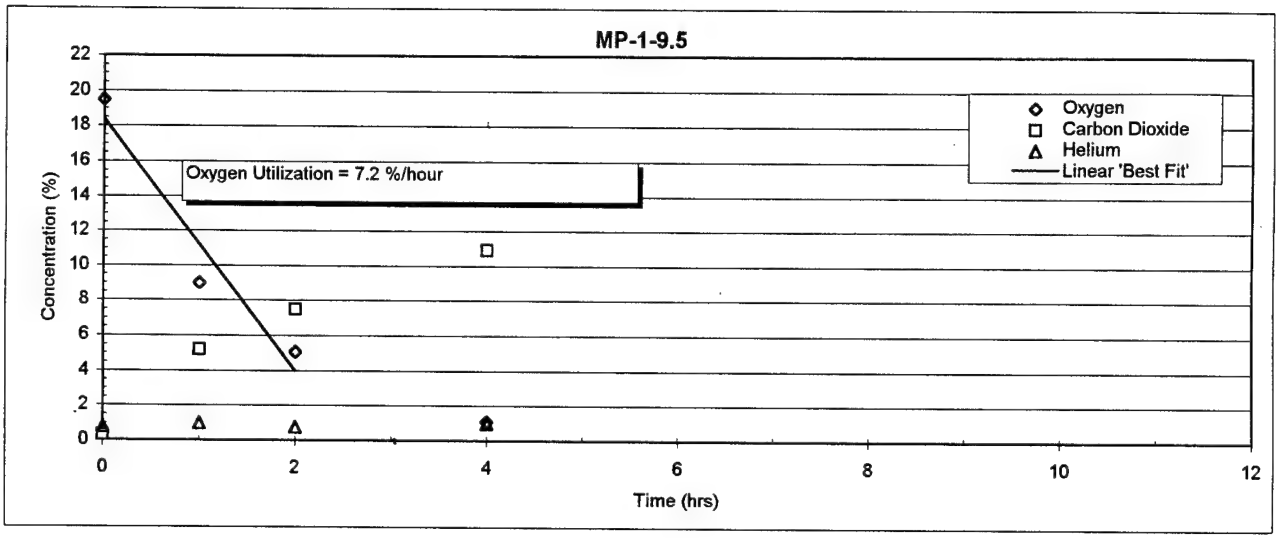


Figure 3 - 20 Pre-Startup Respiration Test Results for MP-2-5.5 and MP-2-8.5 at Nose Dock Area #2

Time[1] (hrs)	MP-1-9.5 O_2	CO_2	TVH	Helium	Time[2]	MP-4-7 O_2	CO_2	TVH	Helium
0	19.5	0.3	481	0.8	0	20.0	0.0	5	0.4
1	9.0	5.2	500	1.0	2	19.9	0.5	110	1.0
2	5.1'	7.5		0.8	4	19.9	0.8	29	1.0
4	1.1	10.9		1.0	6	19.1	1.2	41	1.0
	End of test				24	18.9	2.1	14	1.0
					30	18.5	2.5		1.0
					47	17.4	3.0	16	1.1
					69	16.2	3.3	3	0.7
					76	15.9	3.3	37	0.5
					95	14.8	3.9	44	0.5

[1] Test began on 10/2/96 at 08:00

[2] Test began on 10/2/96 at 10:00



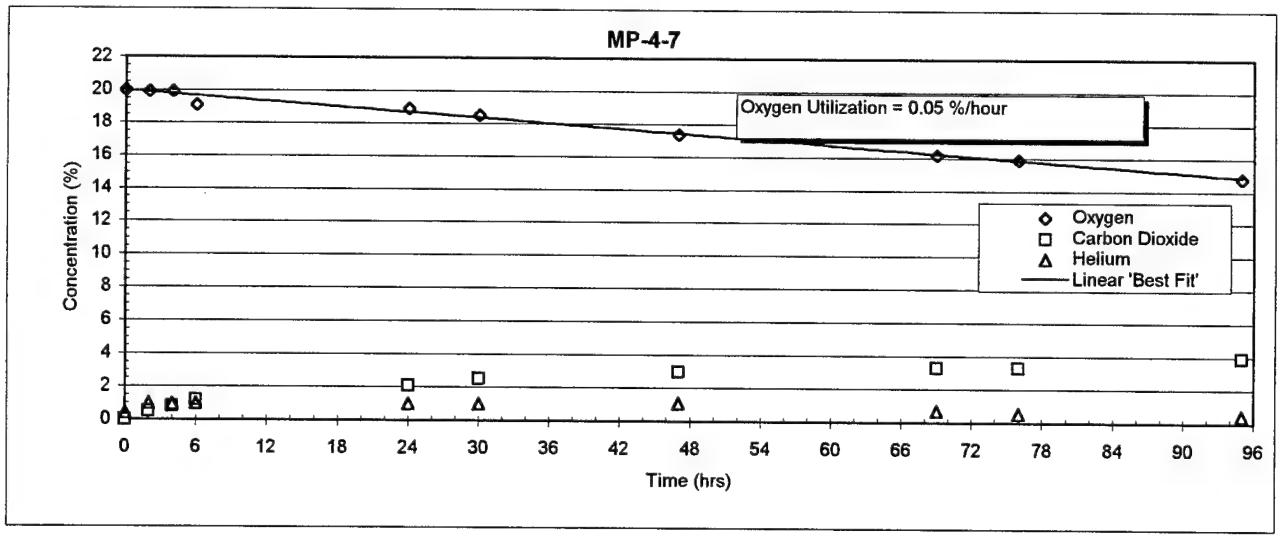


Figure 3 - 21 Pre-Startup Respiration Test Results for MP-1-9.5 and MP-4-7 at Nose Dock Area #5

Time[1] (hrs)	MP-6-3-8.0			
	O_2	CO_2	TVH	Helium
0	20.2	0	191	1.5
2	19.4	0	3	1.3
4	19.7	0	3	1.1
6	19.8	0	4	1.2
8	19.7	0.1		1.1
24	19.1	0.4	7	0.98
28	19.2	0.4	500	1
32	19.4	0.4	38	1.3
50	19	0.5	19	1
73.5	18.9	0.6	10	0.74

[1] Test began on 10/1/96 at 08:00

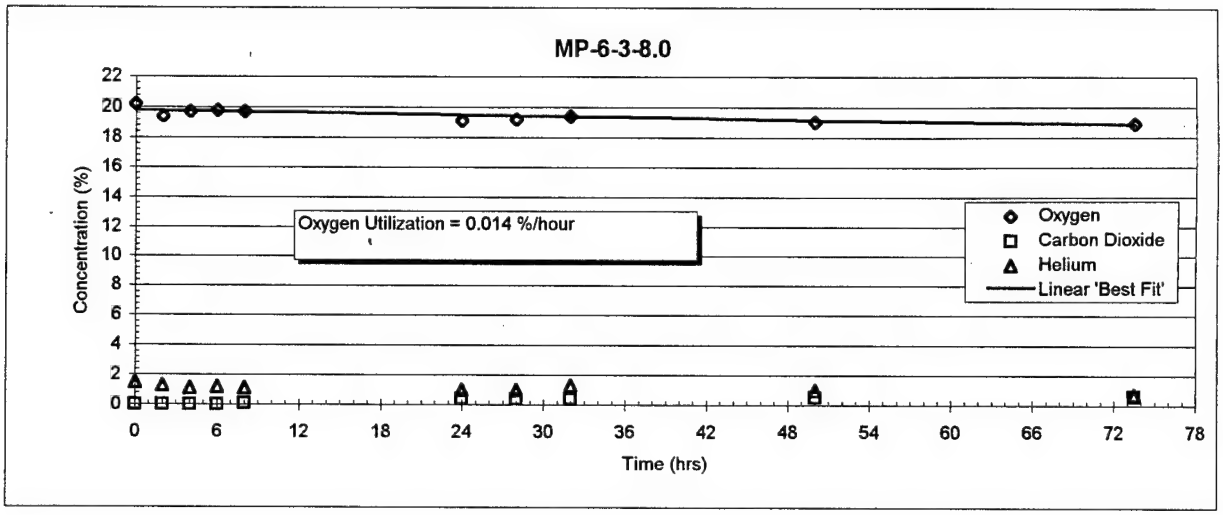


Figure 3 - 22 Pre-Startup Respiration Test Results for MP-6-3-8.0 at Nose Dock Area #6

- **NDA #7**. None of the four AIWs are currently accepting flow at an injection pressure of 3.5 psi. Water has been encountered in the site's sole MP, therefore no soil gas samples have been collected nor respiration test performed.

- **NDA #8**. 43 percent of the 23 AIWs are accepting flow, primarily the AIWs at the northern end of the system. One soil gas sample collected in September had an oxygen level of 16.4 percent. Therefore, a respiration test was not performed at this location.

Overall Recommendation for NDAs: Continue current operations through the 1997 spring and early summer season. Determine whether conditions noted in September, December, and January are representative of site(s). If so, more soil gas information is needed from each of the sites. Injection of air has failed at four zones within the NDA. These areas (south end of NDA #3, northeast arm of NDA #4, NDA #7, and north end of NDA #8) are likely not being aerated. The biovent system at NDA #7 has been operating for several months and still has yet to have an AIW inject air. If air cannot be injected into these areas, another remedial action (i.e., excavation and removal) should be considered as an option. Installation of oxygen sensors are suggested in areas where soils frequently become saturated.

3.10 POWER PLANT DRAINAGE PIPE

3.10.1 Operations

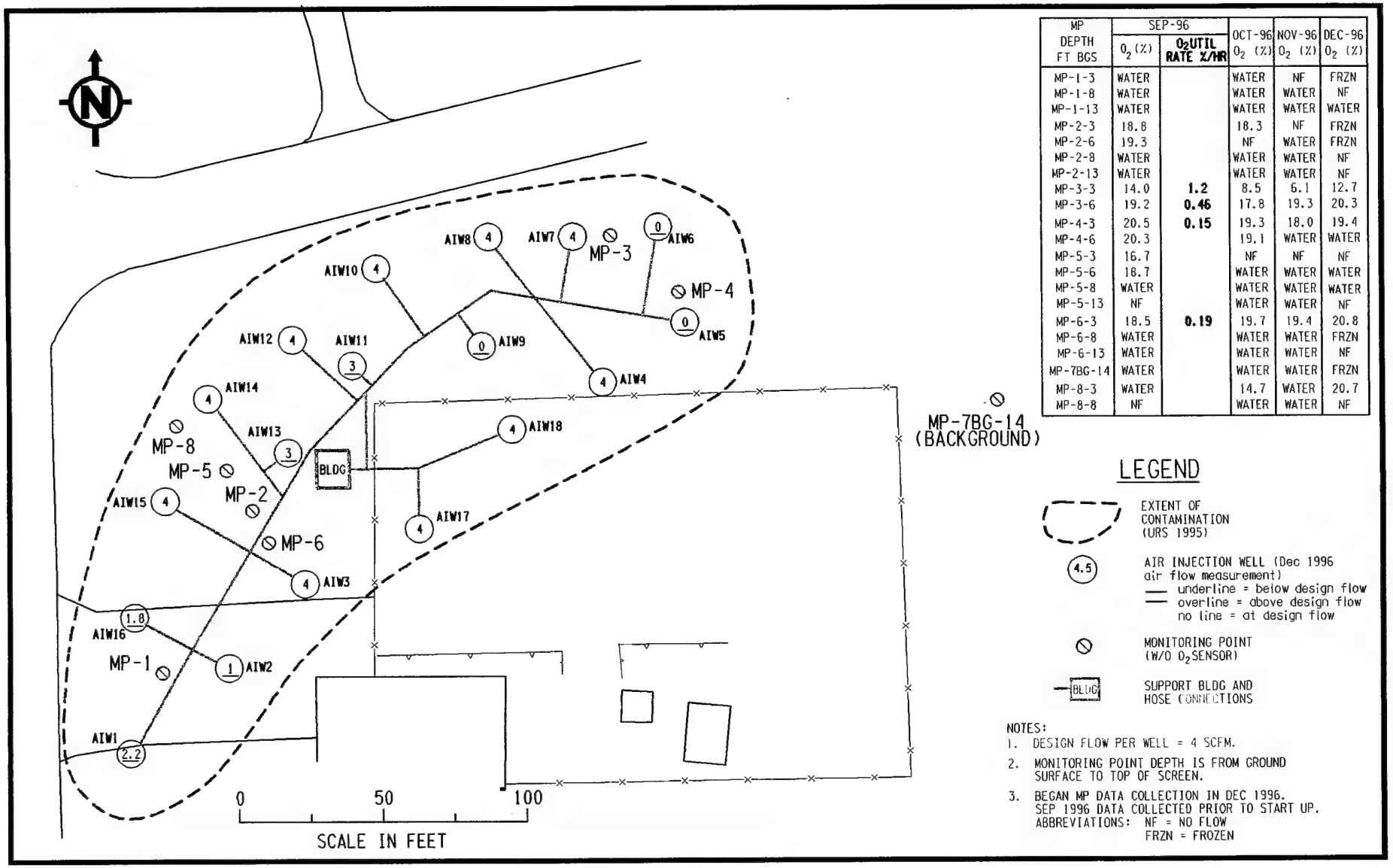
The PPDP, located in OU 9, consists of 18 AIWs and 21 MPs (Figure 3-23). The PPDP biovent system was installed by BEI in the fall of 1995. Since BEI assumed responsibility for the bioventing O&M, the system has operated 298 days. This system was down during portions of the summer due to high water levels, but has operated continuously since mid-July, with minor interruptions for respiration testing and general maintenance.

System flows averaged approximately 2 cfm per well during the fall (design flow is 4 cfm) and were increased to 3 and 4 scfm per well in December and January, respectively (Table 3-17). The increase in flow was due to raising the injection pressure from 1.4 to 2.8 psi.

3.10.2 Conclusions and Recommendations

In general, all of the AIWs are functioning per design. The majority of the contaminated area is being aerated at airflow rates at or below the 4 scfm design rate. Oxygen levels taken from MPs were all above the 5 percent reference level. MP-3-3 had oxygen levels decrease from 14 to 6.1 percent, but due to colder temperatures and an increased injection flow in December, levels rose again to 12.7 percent. All other MPs had levels above 10 percent.

Fall respiration results averaged 0.5 percent/hr based on tests performed on MPs 3-3, 3-6, 4-3, and 6-3 (Figures 3-24 and 3-25). These same points had an average summer respiration rate of 0.86 percent/hr. The decrease in rates is likely attributed to a decrease in the substrate available for microbial consumption. MP-2-3 did not have a fall respiration test performed due to poor soil gas yield.



MP DEPTH FT BGS	SEP-96 O_2 (%)	SEP-96 O_2 UTIL RATE %/HR	OCT-96 O_2 (%)	NOV-96 O_2 (%)	DEC-96 O_2 (%)
MP-1-3	WATER		WATER	NF	FRZN
MP-1-8	WATER		WATER	WATER	NF
MP-1-13	WATER		WATER	WATER	WATER
MP-2-3	18.8		18.3	NF	FRZN
MP-2-6	19.3		NF	WATER	FRZN
MP-2-8	WATER		WATER	WATER	NF
MP-2-13	WATER		WATER	WATER	NF
MP-3-3	14.0	**1.2**	8.5	6.1	12.7
MP-3-6	19.2	**0.46**	17.8	19.3	20.3
MP-4-3	20.5	**0.15**	19.3	18.0	19.4
MP-4-6	20.3		19.1	WATER	WATER
MP-5-3	16.7		NF	NF	NF
MP-5-6	18.7		WATER	WATER	WATER
MP-5-8	WATER		WATER	WATER	WATER
MP-5-13	NF		WATER	WATER	NF
MP-6-3	18.5	**0.19**	19.7	19.4	20.8
MP-6-8	WATER		WATER	WATER	FRZN
MP-6-13	WATER		WATER	WATER	NF
MP-7BG-14	WATER		WATER	WATER	FRZN
MP-8-3	WATER		14.7	WATER	20.7
MP-8-8	NF		WATER	WATER	NF

LEGEND

EXTENT OF CONTAMINATION (URS 1995)

4.5 — AIR INJECTION WELL (Dec 1996 air flow measurement)
— underline = below design flow
— overline = above design flow
no line = at design flow

MONITORING POINT (W/O O_2 SENSOR)

BLDG — SUPPORT BLDG AND HOSE CONNECTIONS

NOTES:
1. DESIGN FLOW PER WELL = 4 SCFM.
2. MONITORING POINT DEPTH IS FROM GROUND SURFACE TO TOP OF SCREEN.
3. BEGAN MP DATA COLLECTION IN DEC 1996. SEP 1996 DATA COLLECTED PRIOR TO START UP.
ABBREVIATIONS: NF = NO FLOW
FRZN = FROZEN

22784/043/FIG2-20.DGN

Figure 3-23
PPDP Biovent System Layout and Well Head Flow (Dec 1996 Air Flow)

Table 3 - 17 PPDP Air Flow and Monitoring Point Data

Air Injection Well	Screen Interval ft/bgs top	bottom	Overburden Pressure[1] (psi)	Design Air Flow (scfm)	Individual Well Head Flow (scfm) September 1996	October 1996	November 1996	December 1996	January 1997
AIW-1	8.9	13.8	6.2	4	0.5	0.0	0.0	nr	4.0
AIW-2	8.9	13.8	6.2	4	0.0	0.0	0.0	3.0	4.0
AIW-3	6.8	11.8	4.7	4	2.2	2.0	1.2	3.0	4.0
AIW-4	4.6	9.5	3.2	4	3.0	3.0	2.0	3.0	4.0
AIW-5	6.9	11.8	4.8	4	0.0	0.0	0.0	3.0	4.0
AIW-6	6.9	11.8	4.8	4	0.0	0.0	0.0	0.0	2.5
AIW-7	3.2	8.1	2.2	4	4.2	4.3	3.0	3.0	4.0
AIW-8	7.8	11.8	5.4	4	4.0	4.0	4.0	2.8	2.8
AIW-9	7.8	11.8	5.4	4	0.0	0.0	0.0	3.0	4.0
AIW-10	7.8	11.8	5.4	4	4.6	0.5	4.0	3.0	4.0
AIW-11	6.9	11.8	4.8	4	0.0	1.2	0.0	3.0	4.0
AIW-12	6.9	11.8	4.8	4	3.6	0.5	4.0	2.5	3.3
AIW-13	6.9	11.8	4.8	4	2.0	1.4	0.0	3.0	4.0
AIW-14	4.9	9.8	3.4	4	3.2	0.5	3.0	0.0	0.0
AIW-15	5.5	10.5	3.8	4	4.0	0.5	2.5	3.0	4.0
AIW-16	8.9	13.8	6.2	4	0.0	1.3	0.0	3.0	4.0
AIW-17	6.9	11.8	4.8	4	1.0	1.0	1.0	3.0	4.0
AIW-18	4.7	9.7	3.3	4	2.8	0.5	3.0	3.0	4.0
Total air flow:				72	35.1	20.7	27.7	44.3	64.6
Blower Information									
Date:					9/10/96	10/10/96	11/12/69	12/18/96	1/8/97
Time:					1030	0830	946	1330	0800
Exit Temperature (°F):					74	64	60	75	58
Pressure (psi):					1.3	1.4	1.4	2.5	2.8

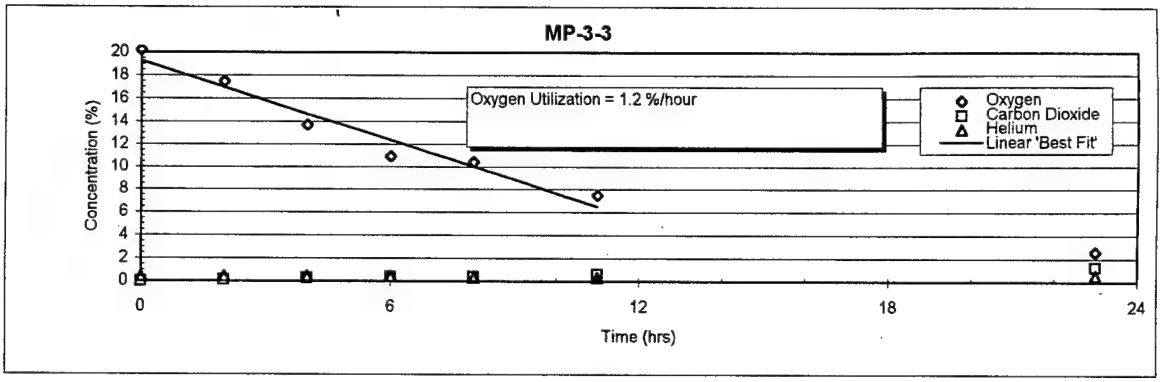
Monitoring Point	Screen Interval (ft bgs) top	bottom		Soil Gas Sampling Results September 1996 O_2 (%)	CO_2 (%)	TVH (ppmv)	October 1996 O_2 (%)	CO_2 (%)	TVH (ppmv)	November 1996 O_2 (%)	CO_2 (%)	TVH (ppmv)	December 1996 O_2 (%)	CO_2 (%)	TVH (ppmv)	January 1997 O_2 (%)	CO_2 (%)	TVH (ppmv)
MP-1-3	3	3.5			Water in line			Water in line			No flow			Frozen			Frozen	
MP-1-8	8	8.5			Water in line			Water in line			Water in line			No flow			Frozen	
MP-1-13	13	13.5			Water in line			Water in line			Water in line			Water in line			Frozen	
MP-2-3	3	3.5		18.8	2.2	5	18.3	1.5	25		No flow			Frozen			Frozen	
MP-2-6	6	6.5		19.3	1.4	55		No flow			Water in line			Frozen			Frozen	
MP-2-8	8	8.5			Water in line			Water in line			Water in line			No flow			Frozen	
MP-2-13	13	13.5			Water in line			Water in line			Water in line			No flow			Frozen	
MP-3-3	3	3.5	O_2 Util. Rate = 1.2%/hr[2]	14.0	5.8	200	8.5	10	90	6.1	11.9	0	12.7	6.3	143		Frozen	
MP-3-6	6	6.5	O_2 Util. Rate = 0.46%/hr[2]	19.2	1.5	121	17.8	1.7	80	19.3	0.3	55	20.3	1	125		Frozen	
MP-4-3	3	3.5	O_2 Util. Rate = 0.15%/hr[2]	20.5	0.8	5	19.3	0.9	3	18.0	1.8	1.7	19.4	1	1		Frozen	
MP-4-6	6	6.5		20.3	1.4	3	19.1	1.2	10		Water in line			Water in line			Frozen	
MP-5-3	3	3.5		16.7	5.4	27		No flow			No flow			No flow			Frozen	
MP-5-6	6	6.5		18.7	1.7	6		Water in line			Water in line			Water in line			Frozen	
MP-5-8	8	8.5			Water in line			Water in line			Water in line			Water in line			Frozen	
MP-5-13	13	13.5			No flow			Water in line			Water in line			No flow			Frozen	
MP-6-3	3	3.5	O_2 Util. Rate = 0.19%/hr[2]	18.5	2.4	28	19.7	0.5	8	19.4	0.4	123	20.8	0	1.8		Frozen	
MP-6-8	8	8.5			Water in line			Water in line			Water in line			Frozen			Frozen	
MP-6-13	13	13.5			Water in line			Water in line			Water in line			No flow			Frozen	
MP-7BG-9	9	14.5	Background location		Water in line			Water in line			Water in line			Frozen			Frozen	
MP-8-3	3	3.5			Water in line		14.7	6	0		Water in line		20.7	7.1	4.3		Frozen	
MP-8-6	6	6.5			No flow			Water in line			Water in line			No flow			Frozen	

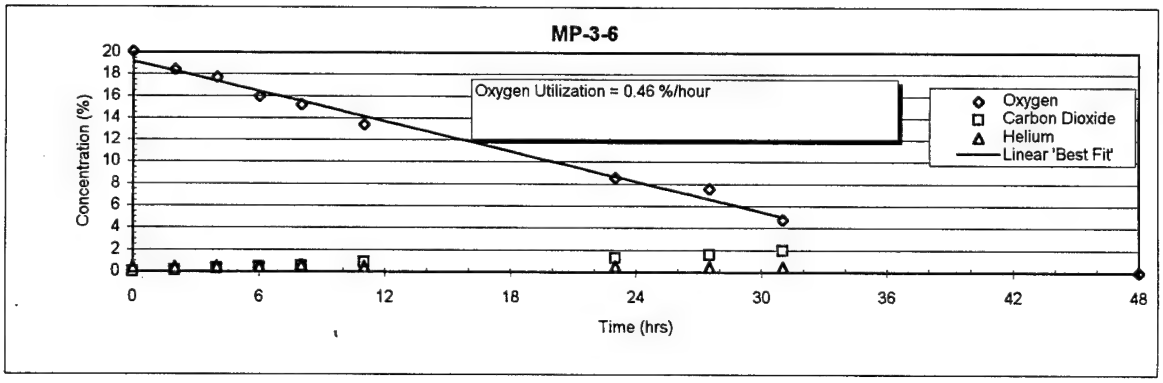
[1] Maximum pressure before potential for fracturing of soil. Calculated at top of screen assuming density of soil is 100 lbs/ft^3.
[2] Test performed on 9/25/96.

N_PPDP.XLS
6/4/97

Time[1] (hrs)	MP-3-3				MP-3-6				MP-4-3			
	O_2	CO_2	TVH	Helium	O_2	CO_2	TVH	Helium	O_2	CO_2	TVH	Helium
0	20.2	0	23	0.45	20.1	0	10	0.43	20.3	0	8	0.42
2	17.5	0.1	58	0.42	18.4	0.1	71	0.43	20	0	3	0.42
4	13.7	0.3	70	0.45	17.7	0.3	60	0.44	20	0	4	0.45
6	10.9	0.4	57	0.45	16	0.4	87	0.49	20	0	3	0.49
8	10.4	0.4	55	0.36	15.2	0.5	105	0.56	19.5	0	4	0.46
11	7.5	0.6	65	0.33	13.4	0.9	128	0.45	19.4	0	8	0.48
23	2.6	1.3		0.55	8.6	1.3	103	0.55	17.7	0.3	6	0.63
27.5		End of test			7.6	1.6	124	0.48	17.3	0.3	5	0.58
31					4.8	2		0.49	16.7	0.3		0.66
48						End of test			14.1	0.5	4	0.59
56.5									12.6	0.7	16	0.56
72									11.1	0.8	5	0.52
80.5									8.6	1.1		0.5
100									7.9	1.2		0.43

[1] Test began on 9/25/96 at 08:00





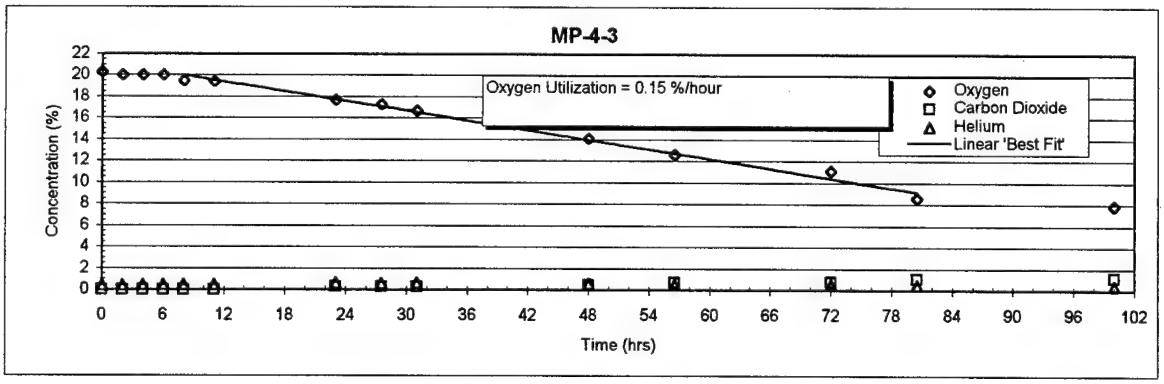


Figure 3 - 24 Fall 1996 Respiration Test Results for MP-3-3, MP-3-6, and MP-4-3 at the Power Plant Drainage Pipe

Time[1] (hrs)	MP-2-3				MP-6-3			
	O_2	CO_2	TVH	Helium	O_2	CO_2	TVH	Helium
0	8.5	1.9	25	0.63	20.1	0	3	0.67
2	Low air yield (test abandoned)				19.9	0.2	2	0.7
4					19.6	0.3	1	0.69
6					19.2	0.3	2	0.67
9					18.3	0.4	14	0.81
21					16.1	0.6	8	0.71
25.5					15.3	0.7		0.75
30					14.2	0.8		0.65
46					11.8	0.9	12	0.63
53.5					10.1	1	25	0.67
70					6.7	1.2	6	0.66
78.5					4.9	1.3		0.56

[1] Test began on 9/25/96 at 10:00

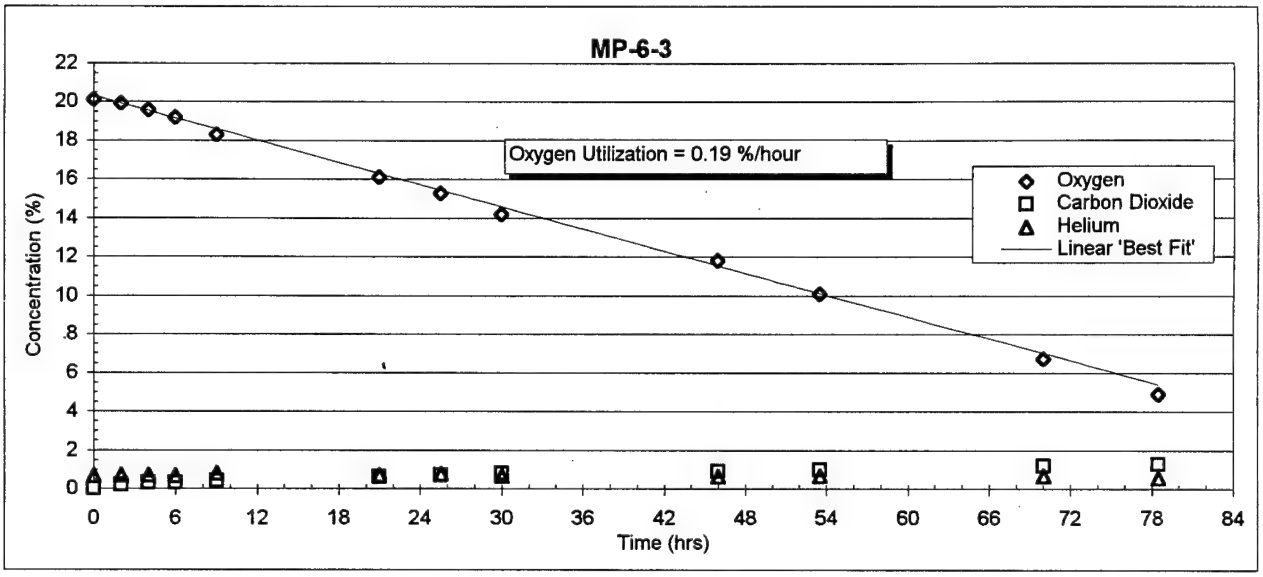


Figure 3 - 25 Fall 1996 Respiration Test Results for MP-2-3 and MP-6-3 at the Power Plant Drainage Pipe

Overall Recommendation for PPDP: An oxygen sensor needs to be considered for the southern end of the PPDP area. This area appears to contain perched water and therefore impedes the collection of soil gas from MP-1 and deeper intervals of MPs-2, 5, 6, and 8. Continue to run respiration tests in the northern area (i.e., MP-3 and MP-4). The area north of the support building yet south of MP-3 does not contain any MPs. Suggest adding another MP in this area or collecting soil samples to determine whether soil is still contaminated.

3.11 VEHICLE MAINTENANCE BUILDING

3.11.1 Operations

The VMB, located in OU 11, consists of 25 AIWs and 31 MPs (Figure 3-26). The VMB biovent system was installed by BEI in the fall of 1995. Since BEI has assumed responsibility for the bioventing O&M, the system has operated 285 days. This system was down during portions of the summer due to high water levels, but has operated continuously since mid-July, with minor interruptions for respiration testing and general maintenance.

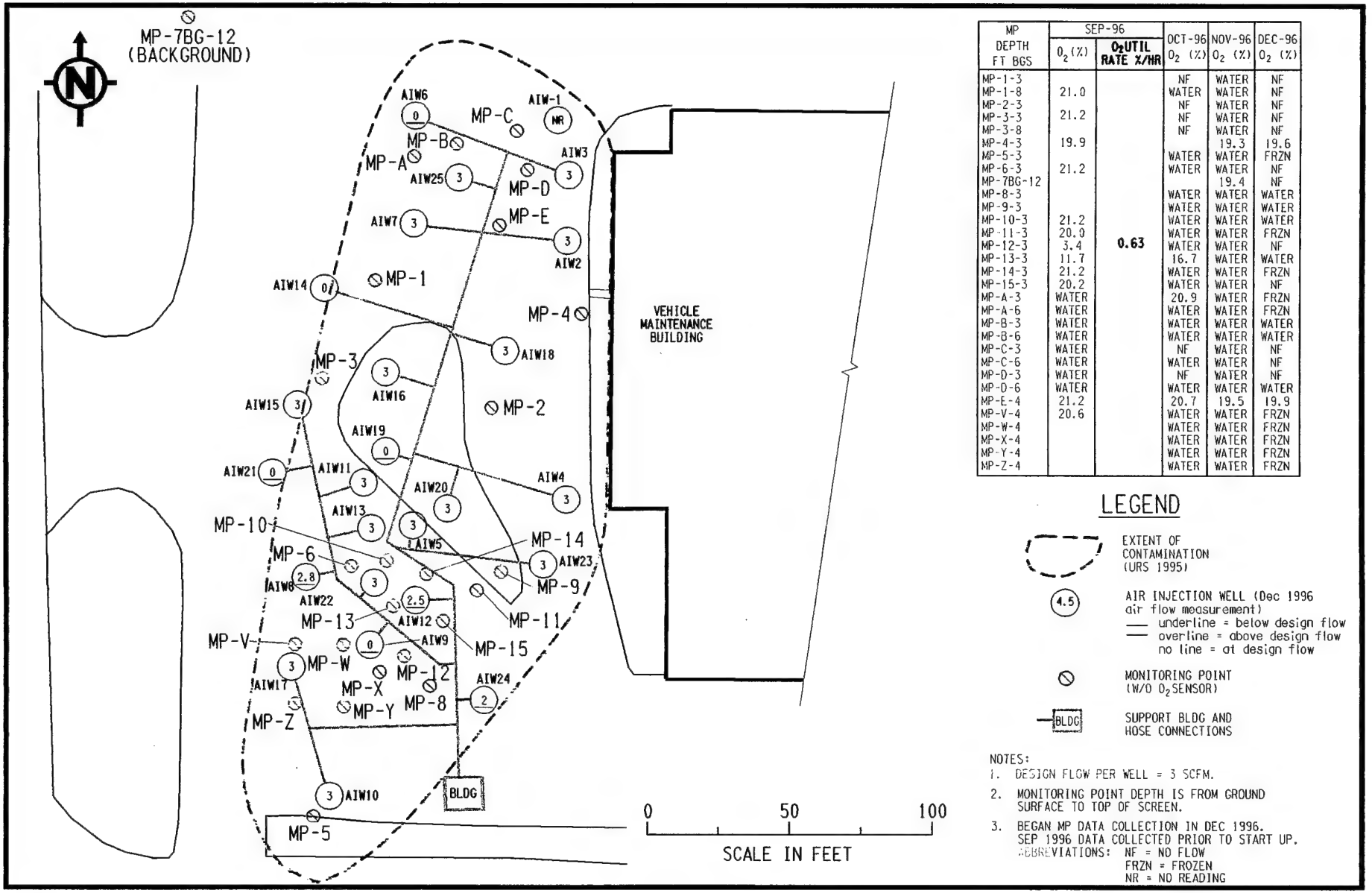
Average flows from the AIWs increased from 1.8 cfm (design 3.0 cfm) in September to 3.6 cfm in December (Table 3-18). The increase in flow is attributed to an increase in injection pressure (1.5 to 2.8 psi) and decrease in site water levels. During the month of January 1997, 24 of the 25 AIWs were taking air at or above the design flow rate.

3.11.2 Conclusions and Recommendations

Soil gas sampling has yielded sporadic results, with the number of MPs being sampled ranging from 12 in September to 3 in October and November. The oxygen levels were predominately over 10 percent, with the exception of MP-12-3, which had an oxygen level of 3.4 percent in September. Subsequent soil gas sampling at this point was limited due to water influences.

No respiration tests were performed at the VMB during the summer due to lack of available MPs. A fall respiration test was performed at MP-12-3. This point was selected based on low oxygen levels measured in September. The tests results showed a oxygen utilization rate of 0.63 percent/hr, but due to the decrease in helium concentrations during the test, it is uncertain whether this oxygen loss is due to bacterial respiration or diffusion (Figure 3-27).

Overall Recommendations for VMB: The biovent system at the VMB was subject to a technical memorandum discussing possible remedial alternatives to bioventing (BEI 1996f). Conclusions drawn from this technical memorandum show that while the biovent system at the VMB is injecting air, the lack of available soil gas and respiration data makes it uncertain as to how the system is actually functioning. The recommended alternative, based on this memorandum, was to continue to operate the system through the winter and spring, at which point the system is to be turned off and confirmation samples collected. If the results from the confirmation samples indicate that the preliminary remediation goals have not been met, the contaminated areas are to be excavated and disposed of in Landfill 3.



MP DEPTH FT BGS	SEP-96 O_2 (%)	SEP-96 O_2 UTIL RATE %/HR	OCT-96 O_2 (%)	NOV-96 O_2 (%)	DEC-96 O_2 (%)
MP-1-3			NF	WATER	NF
MP-1-8	21.0		WATER	WATER	NF
MP-2-3			NF	WATER	NF
MP-3-3	21.2		NF	WATER	NF
MP-3-8			NF	WATER	NF
MP-4-3	19.9			19.3	19.6
MP-5-3			WATER	WATER	FRZN
MP-6-3	21.2		WATER	WATER	NF
MP-7BG-12				19.4	NF
MP-8-3			WATER	WATER	WATER
MP-9-3			WATER	WATER	WATER
MP-10-3	21.2		WATER	WATER	WATER
MP-11-3	20.0		WATER	WATER	FRZN
MP-12-3	3.4	0.63	WATER	WATER	NF
MP-13-3	11.7		16.7	WATER	WATER
MP-14-3	21.2		WATER	WATER	FRZN
MP-15-3	20.2		WATER	WATER	NF
MP-A-3	WATER		20.9	WATER	FRZN
MP-A-6	WATER		WATER	WATER	FRZN
MP-B-3	WATER		WATER	WATER	WATER
MP-B-6	WATER		WATER	WATER	WATER
MP-C-3	WATER		NF	WATER	NF
MP-C-6	WATER		WATER	WATER	NF
MP-D-3	WATER		NF	WATER	NF
MP-D-6	WATER		WATER	WATER	WATER
MP-E-4	21.2		20.7	19.5	19.9
MP-V-4	20.6		WATER	WATER	FRZN
MP-W-4			WATER	WATER	FRZN
MP-X-4			WATER	WATER	FRZN
MP-Y-4			WATER	WATER	FRZN
MP-Z-4			WATER	WATER	FRZN

LEGEND

EXTENT OF CONTAMINATION (URS 1995)

4.5 — AIR INJECTION WELL (Dec 1996 air flow measurement)
underline = below design flow
overline = above design flow
no line = at design flow

MONITORING POINT (W/O O_2 SENSOR)

BLDG — SUPPORT BLDG AND HOSE CONNECTIONS

NOTES:
1. DESIGN FLOW PER WELL = 3 SCFM.
2. MONITORING POINT DEPTH IS FROM GROUND SURFACE TO TOP OF SCREEN.
3. BEGAN MP DATA COLLECTION IN DEC 1996. SEP 1996 DATA COLLECTED PRIOR TO START UP.

ABBREVIATIONS: NF = NO FLOW
FRZN = FROZEN
NR = NO READING

22784/043/FIG2-22.DGN

Figure 3-26
VMB Biovent System Layout and Well Head Flow (Dec 1996 Air Flow)

Table 3 - 18 VMB Air Flow and Monitoring Point Data

Air Injection Well	Screen Interval ft/bgs top	bottom	Overburden Pressure[1] (psi)	Design Air Flow (scfm)	Individual Well Head Flow (scfm) September 1996	October 1996	November 1996	December 1996	January 1997
AIW-1	3	15	2.1	3	4.0	5.4	nr	nr	4.0
AIW-2	1.8	6.8	1.3	3	4.0	5.2	4.0	3.0	4.0
AIW-3	1.9	13.9	1.3	3	2.2	3.0	3.4	3.0	4.0
AIW-4	2.9	7.8	2.0	3	1.6	2.0	2.0	3.0	4.0
AIW-5	2.9	7.8	2.0	3	2.4	3.5	3.5	3.0	4.0
AIW-6	3.8	13.8	2.6	3	0.0	0.0	0.0	0.0	2.5
AIW-7	3.8	13.8	2.6	3	2.8	3.8	3.0	3.0	4.0
AIW-8	2.9	7.8	2.0	3	0.0	1.5	2.8	2.8	2.8
AIW-9	2.9	7.8	2.0	3	2.6	3.0	3.0	3.0	4.0
AIW-10	3	7.9	2.1	3	2.4	3.0	3.0	3.0	4.0
AIW-11	3	8	2.1	3	2.8	4.0	4.0	3.0	4.0
AIW-12	3.5	6.5	2.4	3	0.0	1.0	3.5	2.5	3.3
AIW-13	2.9	7.8	2.0	3	1.7	1.5	2.5	3.0	4.0
AIW-14	8.9	13.9	6.2	3	0.0	0.0	0.0	0.0	0.0
AIW-15	2.9	7.8	2.0	3	1.0	1.0	0.0	3.0	4.0
AIW-16	2.9	7.8	2.0	3	3.6	4.8	4.0	3.0	4.0
AIW-17	2.9	7.8	2.0	3	2.1	2.8	3.0	3.0	4.0
AIW-18	2.9	7.8	2.0	3	2.1	2.6	2.5	3.0	4.0
AIW-19	2.9	7.8	2.0	3	0.0	1.5	1.5	0.0	4.0
AIW-20	2.9	7.8	2.0	3	2.3	3.0	2.4	3.0	4.0
AIW-21	2.9	7.8	2.0	3	0.0	0.0	0.5	0.0	2.8
AIW-22	2.9	7.8	2.0	3	1.4	2.5	3.0	3.0	4.0
AIW-23	2.9	7.8	2.0	3	1.9	2.5	3.0	3.0	4.0
AIW-24	2.9	7.8	2.0	3	1.0	2.0	2.0	2.0	4.0
AIW-25	2.9	7.8	2.0	3	2.8	3.6	3.8	3.0	4.0
Total air flow:				75	44.7	63.2	60.4	58.3	91.4
Blower Information									
Date:					9/9/96	10/10/96	11/11/96	12/18/96	1/8/97
Time:					17:00	1320	1330	1330	0800
Exit Temperature (°F):					72	75	70	75	58
Pressure (psi):					1.5	2.3	2.55	2.5	2.8

Monitoring Point	Screen Interval (ft bgs) top	bottom		Soil Gas Sampling Results September 1996 O_2 (%)	CO_2 (%)	TVH (ppmv)	October 1996 O_2 (%)	CO_2 (%)	TVH (ppmv)	November 1996 O_2 (%)	CO_2 (%)	TVH (ppmv)	December 1996 O_2 (%)	CO_2 (%)	TVH (ppmv)	January 1997 O_2 (%)	CO_2 (%)	TVH (ppmv)
MP-1-3	3	3.5			No flow						Water in line			No Flow			Frozen	
MP-1-8	6.5	7		21.0	0.0	410		Water in line			Water in line			No Flow			Frozen	
MP-2-3	3	3.5			No flow						Water in line			No Flow			Frozen	
MP-3-3	3	3.5		21.2	0.0			No flow			Water in line			No Flow			Frozen	
MP-3-8	6.5	7						No flow			Water in line			No Flow			Frozen	
MP-4-3	3	3.5		19.9	1.4	22				19.3	0.5	19	19.6	0.3	19		Frozen	
MP-5-3	3	3.5						Water in line			Water in line			Frozen			Frozen	
MP-6-3	3	3.5		21.2	0.0	29		Water in line			Water in line			No Flow			Frozen	
MP-7BG-6.4	6.35	12	Background location							19.4	0	36		No Flow			Frozen	
MP-8-3	3	3.5						Water in line			Water in line			Water in line			Frozen	
MP-9-3	3	3.5						Water in line			Water in line			Water in line			Frozen	
MP-10-3	3	3.5		21.2	0.0	9		Water in line			Water in line			Water in line			Frozen	
MP-11-3	3	3.5		20.0	0.6	18		Water in line			Water in line			Frozen			Frozen	
MP-12-3	3	3.5	O_2 Util. Rate = 0.63%/hr[2]	3.4	13.2	800		Water in line			Water in line			No Flow			Frozen	
MP-13-3	3	3.5		11.7	6.3	6500	16.7	3	5200		Water in line			Water in line			Frozen	
MP-14-3	3	3.5		21.2	0.0	15		Water in line			Water in line			Frozen			Frozen	
MP-15-3	3	3.5		20.2	0.0	64		Water in line			Water in line			No Flow			Frozen	
MP-A-3	3	3.5			Water in line		20.9	0	20		Water in line			Frozen			Frozen	
MP-A-6	6	6.5			Water in line			Water in line			Water in line			Frozen			Frozen	
MP-B-3	3	3.5			Water in line			Water in line			Water in line			Water in line			Frozen	
MP-B-6	6	6.5			Water in line			Water in line			Water in line			Water in line			Frozen	
MP-C-3	3	3.5			Water in line			No flow			Water in line			No Flow			Frozen	
MP-C-6	6	6.5			Water in line			Water in line			Water in line			No Flow			Frozen	
MP-D-3	3	3.5			Water in line			No flow			Water in line			No Flow			Frozen	
MP-D-6	6	6.5			Water in line			Water in line			Water in line			Water in line			Frozen	
MP-E-4	3	3.5		21.2	0.0	4	20.7	0	2	19.5	0	8.6	19.9	0	5		Frozen	
MP-V-4	4	4.5		20.6	0.4	500		Water in line			Water in line			Frozen			Frozen	
MP-W-4	4	4.5						Water in line			Water in line			Frozen			Frozen	
MP-X-4	4	4.5						Water in line			Water in line			Frozen			Frozen	
MP-Y-4	4	4.5						Water in line			Water in line			Frozen			Frozen	
MP-Z-4	4	4.5						Water in line			Water in line			Frozen			Frozen	

[1] Maximum pressure before potential for fracturing of soil. Calculated at top of screen assuming density of soil is 100 lbs/ft^3.
[2] Test performed on 9/24/96.
nr = no reading

Time[1] (hrs)	MP-12-3			
	O_2	CO_2	TVH	Helium
0	19.8	0	36	1.2
2	18.7	0.1	105	0.5
4	16.6	0.2	168	0.13
6	15.3	0.3	179	0.05
8	13.5	0.5	165	0.01
19	7.9	0.7	180	0
24	7.1	0.8	217	0
29	6.9	0.9	160	0
44	4.6	1.2		0

[1] Test began on 9/24/96 at 11:30

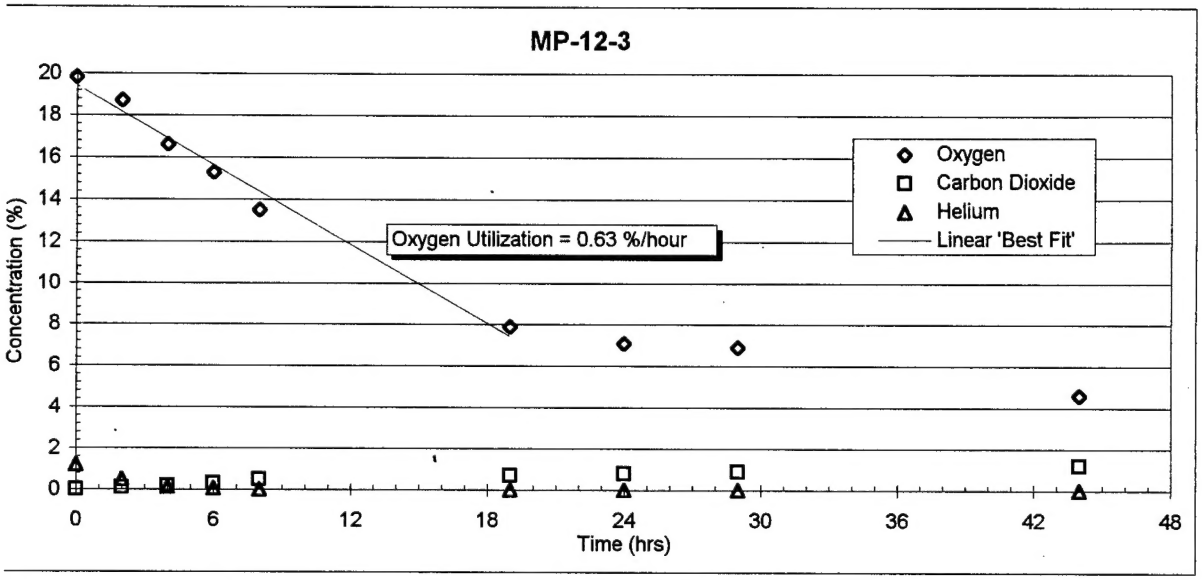


Figure 3 - 27 Fall 1996 Respiration Test Results for MP-12-3 at the Vehicle Maintenance Building

REFERENCES

ABB-ES (ABB-Environmental Services, Inc.), 1994. *Final Remedial Investigation Report, OU-10.* Installation Restoration Program. Loring AFB. August.

ABB-ES, 1995a. *Final Remedial Investigation Report, OU-8.* Installation Restoration Program. Loring AFB. February.

ABB-ES, 1995b. *Final Remedial Investigation Report, OU-9.* Installation Restoration Program. Loring AFB. January.

ABB-ES, 1996. *Final Remedial Investigation Report, OU-11.* Installation Restoration Program. Loring AFB. February.

AFCEE (Air Force Center for Environmental Excellence), 1992. *Test Plan and Technical Protocol for a Field Treatability Test for Bioventing.* May.

BEI (Bechtel Environmental, Inc.), 1996a. *Bioventing at OUs 5, 8, 9, 10, and 11 Removal Action Report.* Final, April.

BEI, 1996b. *Operation and Maintenance Plan for Bioventing at OUs 5, 8, 9, 10, and 11.* Final, January.

BEI, 1996c. *Excavations in OUs 5, 8, 9, 10, and 11 Removal Action Report.* Final, February.

BEI, 1996d. *Bioventing at OUs 5, 8, 9, 10, and 11 Removal Action Work Plan,* Addendum #1. November.

BEI, 1996e. *Biovent Semi-Annual Report.* October

BEI, 1996f. *Bioventing Alternatives Technical Memorandum.* October.

BEI, 1996g. *Monthly Bioventing Report.* September.

BEI, 1996h. *Monthly Bioventing Report.* October.

BEI, 1996i. *Monthly Bioventing Report.* November.

BEI, 1996j. *Monthly Bioventing Report.* December.

BEI, 1997. Draft *Bioventing Removal Action Report Addendum 1.* January

CDM (Camp Dresser McKee), 1996. *Final Remedial Investigation Report, OU-5.* Installation Restoration Report. Loring AFB. February.

Earth Tech, 1995. Technical Report *Long-Term Bioventing Treatability Study,* Loring AFB, Base Exchange Service Station. Final, August.

Patrick St. Peter & Sons Inc., 1997. *Operation and Maintenance Manuals for Nose Dock Area & Service Station.*

URS (URS Consultants, Inc.), 1995a. *Design Analysis Report, OUs 5, 9, 10, and 11.* Final, June.

URS, 1995b. *Bioventing and Excavation Specifications for Former Jet Engine Test Cell, Vehicle Maintenance Building, Power Plant Drainage Pipe, and Entomology Shop.* Final, June.